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Sustainable Water Use and its Contribution to Food Security: Smallholders' Experiences and Recommendations

APEC Policy Partnership on Food Security

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Executive Summary

A three-day seminar on “Smallholders’ Response to New Climate Scenarios regarding Sustainable Water Use as a Contribution to Food Security”[1] was held in Santiago, Chile, on 29-30 November and 1 December 2017. The seminar was successfully implemented, with the participation of 13 speakers and more than 80 participants from 10 APEC economies[2].

Within the framework of the “APEC Food Security Roadmap Towards 2020,” one of the priority objectives is the promotion of regional economic integration through projects related to sustainable agriculture. The Chilean economy conducted a 3-day seminar focused on capacity-building to address urgent climate change issues, and the already-observed adverse effects on water availability for smallholders. This activity was hosted by the Chilean National Irrigation Commission (CNR, Spanish acronym), a state agency with the role of carrying out the National Irrigation Policy and contributing to the efficient use of water resources in irrigated agriculture.

This event was highly relevant for all the APEC economies, offering a forum for the exchange of experiences and different visions. Policy makers, farmers, and researchers, with the objective of improving the adaptive capacity of APEC agriculture to current and future climate change, composed the main audience.

Climate change represents one of the biggest challenges that humankind is currently facing. Present effects are causing serious problems in human and natural populations due to changes in the precipitation and temperature regimes of the planet. These changes have caused substantial negative impacts, including threatening food security, reducing crop production, and affecting small- and medium-scale farmers. Other detected effects are prolonged droughts and increased numbers of extreme precipitation events, which are responsible for flashfloods. All this makes

[1] Official website: http://seminarios-cnr.herokuapp.com/presentation/list/
[2] Assistant Economies: Canada; Chile; China; Indonesia; Malaysia; Mexico;, Peru; Russia; Thailand and Viet Nam

adaptation to climate change scenarios even more complex. Different variables determine rural capacities to deal with these impacts. Among them, we have socio-economic, cultural, and ethnic factors, as well as local policies, laws, and regulations. Small- and medium-scale farmers will have to incorporate different adaptation strategies to cope with climate change impacts, strengthen their capacity to address these changes, and be prepared for future changes.

The challenges that smallholders face within the APEC economies have some important common features. However, the ways in which institutional structures can respond to these changes depend on individual characteristics of those economies, where different governance structures create specific incentives and opportunities for smallholders to act and adapt to known and unforeseen changes.

This report presents the context of climate change on smallholders in various parts of the APEC region, and examines a range of responses that have been undertaken to help address some of the effects of climate change that are already being seen in these regions. As such, this report provides a breadth of experiences that can help provide an understanding of the diversity of options that are available to smallholders, both from a top-down approach (governmental actions, through law, regulation, or economic policy) and a bottom-up approach (individuals and communities working to produce solutions, either individually or through partnerships).

In addition, the report describes the methodology and results of the workshop for participants at the APEC conference. The purpose of the workshop was to gather individual knowledge about the awareness and the types of responses that are available and have been taken by the different participant economies in addressing the concerns and known issues facing smallholders to ensure food security in each economy.

INTRODUCTION

The question about future viability of agriculture in the face of climate change is a problem faced by many political leaders, and a subject of intense discussion among academics and scientists from a wide range of disciplines. Assessing the impacts of changes in rainfall patterns – in terms of intensity, total amount, and timing – and increases in temperature – and their effects on relevant indices such as the accumulation of growing degree-days, number frost events, and days with severe heat stress – are all areas of scientific research. The majority of the research has been focused on medium and larger agricultural enterprises, whose economic importance to ‘member economy government economies tends to attract the political attention. However, in many economies – especially throughout the APEC region – smallholders represent a significant fraction of their respective economies.

PART I: Review of Potential Impacts of Climate Change on Smallholder farmers

Smallholder farmer definition

The concept of "smallholder farmer (or smallholder for simplicity)" is often described in terms of either the size of the agricultural parcel, the economic value of production from the landscape, the income generated from a parcel, or the technological state of the farm. The concept is one that changes regionally, based on local cultural contexts. In many economies where agriculture makes up a significant portion of GDP, the vast majority of individuals involved in agriculture are smallholder farmers and their families [1]. The physical context of smallholder farmers varies from subsistence farming to family farms to even retirement properties. However, while most definitions of smallholder tend to focus on crop production, the term can also be used to include pastoralists, who have a dependency on their livestock as a means of living, through selling derived products (such as wool or milk) or meat. Similarly, smallholder can include those who rely on aquaculture and artisanal fisheries. Although less common, these two groups of animal-growers smallholders do have a significant presence in certain areas of the APEC region. Most notably, highland pastoralists are found in Peru and northern Chile, and aquiculture and artisanal fisheries are present in Southeast and East Asian economies.

It is necessary to recognize that there are differences among smallholders related to the contexts in which they are situated, making comparison and especially the identification of unique solutions extremely difficult. For example, according to the United States Department of Agriculture farms in the US are defined based on income, with small farms having less than $350,000 as gross farm income each year [2]. Based on this definition, the median size of a US small farm is 279 acres (113 hectares). In contrast, a smallholder in the Peruvian Amazon could be farming an area of 5 hectares [3], but a value in one area isn't necessarily transferrable to another, due to the different realities of smallholding farmers and the agricultural systems they manage. Continuing with the example of Peru, a smallholder farmer of potatoes in the highlands often cultivates an area of less than 1 hectare of land [1].

In most contexts, smallholders represent a substantially large proportion of all agricultural holdings. In the case of the United States, smallholder farms represent 97% of all farms [2], while in China, they make up 98% of all farms, and in Mexico, it's over 50% [1]. This means that climate change impacts on smallholders have direct population effects – and an associated local economic effect – if such impacts are not well addressed.

Due to the vast range of historical, cultural, and economic reasons, definitions for smallholders must necessarily be broad and somewhat vague. Despite this, smallholders do tend to share some common features. These generally include: a) having their livelihoods tied to their farming practices and that the areas they farm are relatively small, b) labor is generally provided by the family, c) family sizes are generally larger than in urban areas, d) they produce and rely on a range of different products, and e) families are often relatively poor [1]. These characteristics of reliance on family labor [4], growing diversified produce [5], and engaging in off-the-farm economic activities [6] imply that smallholders can be resilient, due to efficiencies of small scale production [7,8], diverse livelihoods, and an ability to exploit a variety of risky niches through processes of adapting to various environmental shocks and managing affairs after the impacts [9,10]. However, while diversification can produce resilience, it can also lead to being spread too thin. Since smallholder farms tend to be on marginal lands that are vulnerable to extreme events [11], and since smallholders lack financial resources, this means that relatively few smallholders are capable of investing in new technologies or crop insurance, thus increasing the risks they face from the range of environmental problems that could occur [1,12]. As such, institutional investments should recognize what the vulnerable points are – socially, economically, and environmentally – in order to provide assistance for key issues.

In this report, we will not seek to define smallholder with a universal definition. Instead, we accept the variety of local definitions that are used to describe the relative context for each economy and region. In this way, the context of the report focuses less on the area under cultivation or management or even the amount of income generated from the land. Instead, we are focusing on the class of farmers, as identified and defined regionally.

Climate Change Impacts in the APEC Region

Based on the findings of the fifth assessment report of the Intergovernmental Panel on Climate Change, Working Group II [13], the risks from climate change to local areas arise from the interacting impacts of changes in precipitation patterns and temperature cycles with non-climatic changes, such as socioeconomic development, land use change, soil fertility, and water demand changes. The interactions between these two sources of change (climate and non-climate related) will lead to changes in farm productivity that will produce different types of exposure and vulnerability for different groups.

Due to spatial resolution issues, the scale of many climate impact studies has focused on large-scale trends and average changes. However, the variability of impacts is likely to often be disparate, with impacts being unequally distributed. Furthermore, this inequality in distribution of impacts will be further affected by wealth and resource inequality. Translating regional trends and forecasts as presented below to the contexts of smallholders will require additional factors that will allow assessments to be placed in social and situational contexts. Specifically, such assessments will need to incorporate the location-specific contexts of smallholders, a number of socioeconomic factors that are affected secondarily by climate change, and assess location-specific climate change impacts that will affect smallholders' livelihoods [12,14].

Water Availability

Throughout much of the Western Pacific, changes in precipitation are expected to increase mean annual runoff (although some areas will not experience significant changes). This projected increase in flows in the region is due to an intensification of the East Asian summer monsoon [15]. One major exception to this is Australia, where the majority of the simulations show that a large fraction of this region will observe an increase in drought frequency [15]. In the Eastern Pacific, on the other hand, the majority of the region will experience a decline in surface runoff, except in tropical areas [16]. One implication for these changes in total annual runoff is that there is an associated increase in groundwater use, leading to declining groundwater levels in areas with decreased runoff [17]. In contrast, in areas with increased runoff, there will be higher a likelihood of flooding events [18] and erosion [19]. Despite these overall trends, though, seasonal differences could run in an opposite direction (e.g., seasonal flooding in drier areas or seasonal dry spells in wetter areas) [20], and these seasonal perturbations can cause additional impacts on cropping choices and water management strategies. Furthermore, the regional nature of some of these impacts could seriously impact smallholders, many of whom have little capacity for investing in long-term strategies (see section on Food Security, below).

In agriculture, changes in climate will affect not only the amount of water entering the system, but it will also affect the water demand of the crops being grown. Global hydrological modeling indicates that irrigation demands could increase by 7 – 21% by 2080, depending on the emission scenario used, with major regional variability [21], which could be problematic for smallholders in their long-term planning.

As an example of the hydrological changes, in Central China, models suggest that there won't be enough water for agriculture by the 2040s, due to increases in water demand in non-agricultural sectors [22]. In the case of smallholders, who occupy more marginal lands in some economies, the ability to respond to such changes in climate can be exacerbated by the impacts of soil quality, with projected irrigation demands likely to exceed local water availability in many places [21,23]. Furthermore, in places reliant on rain-fed agriculture, climate change could be beneficial in monsoon-fed systems [24], but areas expected to see less rainfall overall or increased intensity are more likely to be severely negatively impacted, unless water security measures are taken [25], including improved water management practices [26] or the construction of irrigation works, small-scale reservoirs, and the like.

In the arid Americas, groundwater and surface water sources will become increasingly strained due to a combined effect of climate change and human uses [27]. In the northwestern US and southwestern Canada, decreased snowpack and increased water demand will result in seasonal water shortages, unless management options are instituted [28]. Similarly, the sub-tropical regions of Mexico are expected to see declines in precipitation [29], leading to decreased river discharges [30]. In contrast, the tropical portions of Mexico are not expected to see changes in water availability, until after 2050, when overall water availability is expected to increase, potentially causing damage to in-stream infrastructure [29].

Crop Production

In addition to changes that smallholders will face that are caused by precipitation, climate change is likely to change how the ecology of a region functions. For farmers, this will mean an earlier spring, marked by breeding, bud burst, flowering, and migration patterns shifting earlier in the year [31] and a later autumn, with some areas in higher latitudes already experiencing an advance of the growing season by 5.4 days and a delayed ending of the growing season by 6.6 days [32]. This increased growing season at higher latitudes could bring net benefits to crop production in some areas. However, increased growing seasons that are accompanied by lowered numbers of frost days can decrease the productivity of fruit and nut trees [33] and grapevine [34] in some areas, which often offer a source of income for smallholders. Decreases in the number of frost days can also mean an increase in the abundance and persistence of weeds, pests, and disease, since more individuals will likely be able to survive through the winter, thus increasing their incidence in the following year [35].

Furthermore, the frequency of hot nights during the growing season is also increasing, as is the frequency of extremely high daytime temperatures [36], both of which are particularly damaging to crops [37,38]. These changes can have significant impacts on smallholders, since these would affect the operation of the farm itself, including the types of crops that could be grown as the optimal growing region for crops migrate either pole-ward or to higher elevations [39]. In addition to these changes in temperature, extreme events are still going to occur, but with potentially greater intensity, thus decreasing crop production [40]. Although trends show negative overall impacts of climate change on plant production, different APEC economies will see different effects, due to local climate change trajectories and crops grown.

Rice production could benefit from higher temperatures, especially at higher latitudes, with some areas potentially seeing rice growing seasons increase by as much as 30 days [41]. Since rice can increase its growth rate with higher temperatures, not only does global warming mean some areas have longer growing seasons, it also means that the time to maturation is reduced for that region. Indeed, in China, where rice is the main food crop, the overall changes in productivity has a broad range, depending on a number of factors [42]. However, there are many parts of Southeast Asia where current high temperatures are already close to critical [43], and global warming will mean that overall rice production will decrease [44]. The case of maize in northern China showed only negative implications [45], while winter wheat showed modest positive implications [46].

In Australia, the production of strongly water-dependent crops, like sugarcane [47], will be highly dependent on water availability. However, given sufficient water, yields may increase, so long as temperatures do no exceed physiological limits. In contrast to the expected trends in some places in China, wheat production in Australia could fall below current yields by 2080 [48], and conditions could get extreme enough that the economy would be a net importer of wheat if it proves impossible to sufficiently adapt to future conditions [49].

In Mexico, the available land area that suitable for growing corn is expected to decline by up to half by 2050. The modeled impact from the expected declines in precipitation in wheat-growing areas is expected to lead to sharp declines in production [50]. Furthermore, even though it will receive more precipitation, the additional effect of rising temperatures in Southern Mexico is expected to see a decline in the production of coffee, which is an important cash crop, by 34% by 2020 [51,52].

In central Chile, higher temperatures, fewer frost days, and water scarcity could diminish the production of winter crops and fruits, but these trends are expected to be a benefit to agriculture further south. In the case of maize, there are expected yield reduction in the order of 5% up to 30%, depending on the climate change scenario in central Mediterranean Chile. There are some simple adaptation strategies that can be effective counterbalancing the impacts of a warmer and drier environment, combinations of sowing dates and fertilization rates are two simple ways to cope with climate change[53][54].

Mountain Agriculture

High elevation ecosystems are extremely vulnerable to climate change [55], meaning that smallholders in mountain regions are particularly at risk. Although such smallholders tend to have traditional strategies to handle the extreme environmental conditions and climatic variability found at high elevations, regional economic trends can exacerbate the challenges posed by climatic change. Tropical highlands are often used for livestock grazing, leading to overgrazing and subsequent land degradation [11]. Combined with behavioral patterns associated with poverty and climate change shocks, many highland areas are being consolidated, leading to land cover change and loss of grazing rights [56].

In Peru, the impact of climate change has meant that agricultural pests and diseases have forced highland farmers to move to higher elevations. Projected temperature increases will mean that in 30 years, the thermocline below which potato pests can thrive will have risen above the last areas where potatoes could be grown [57]. Another reality of highland agriculture is that moving to higher elevations in order to escape the impacts of climate change means that the amount of arable land continues to diminish with elevation, meaning lower potential yields, even before incorporating concerns like soil quality and water availability found at higher elevations.

Rangelands and Livestock

In rangelands, the impacts of altered precipitation patterns and increased temperatures will change the phenology of forage plants, due to increased evapotranspiration caused by higher temperatures and consequent reductions in primary productivity in the plant [58]. With expectations of increased inter-annual variability in precipitation affecting most many grasslands [59], overall productivity is likely to decline in mesic areas [60], but increase in more arid regions [61]. Effects of climate change on livestock are to increase the number of days with a temperature humidity index (THI) greater than 80 (heat stress) by as much as 138% by 2070 [62]. Such increases in heat stress will have major repercussions on livestock that are unable to be properly cared for during such heat stress periods, leading to declines in feeding and growth rates [63], declines in milk production [64] and reproduction [65,66], and even livestock mortality. Furthermore, at higher THI values, livestock will have greater water demands, exacerbating regional conditions of water scarcity due to lower precipitation. These livestock responses to heat stress are only expected to be compounded by climate change in areas that will have increased likelihoods of drought.

In addition to the negative physiological responses that livestock will experience due to heat stress, there is also the potential for increased abundances of ectoparasites. In regions where winter operates as a natural mechanism for controlling ectoparasite populations, higher temperatures can increase winter survival and create the opportunity for having large population sizes [59]. For example, horn fly (*Haematobia irritans*) is a major cattle ectoparasite, which can decrease weight-gain by as much as 14%, while ticks (*Amblyomma americanum*) can decrease cattle weight-gain by as much as 30% in some breeds [67]. For pastoralists, all these climate-related impacts will impose significant economic burdens, and may force some to sell off their animals or risk suffering the consequences of livestock morbidity and/or mortality.

In Australia, climate modeling indicates that the gross value of the beef, sheep, and wool sector will decrease by 4% [68], with models showing a shorter growing season for fodder by 2050, due to adverse temperature and precipitation changes [69]. Dairy production in all places, save Tasmania, will decline by 2050 [70], with continued increases in the THI increasing above the historical trend, leading to even lower levels of milk production [71]. In contrast, estimations in New Zealand that included GHG feedbacks showed a potential increase in livestock value [72], but modeling that took the growth of pasture into account indicated that some areas would decline in the long run, while others would need to implement management changes to counteract climatic effects [73].

In contrast, the increase in the THI values across Mexico are expected to outweigh any potential benefits of increased precipitation in southern Mexico through 2020 [74].

Food Security

Farming for smallholders provides a degree of economic and food security, which means that climate change creates the possibility of losing both [75]. An outcome of climate change on global food systems is that the condition of food security will change due to the increased frequency of certain types of extreme climate events. Impacts of extreme events on food availability can vary greatly, but events like the Russian heat wave of 2010 have shown how public policy decisions following such events can have significant impacts on global food commodity markets. Such extreme climate events can have two different types of effects on smallholders: a) loss of income, due to a lost harvest and increased crop insurance costs (where available) and b) loss of savings, caused by repair and recovery costs and a need to purchase food that would normally be grown on the smallholding.

Poor smallholders, who have limited ability to access credit or insurance, are likely to be less inclined to invest in agricultural production as the number of extreme climatic events increase, since all costs associated with losses would be borne by them. Indeed, likely behaviors by smallholders to increased climatic risk is to focus more on low-risk, low-economic value subsistence crops [76], be less likely to invest in fertilizer or other purchased inputs [77], and be less likely to adopt new production technology [78]. This means that smallholders are vulnerable to the direct effect of climate shocks [79] and will also likely fail to take advantage of any potential gains caused by increased prices on a regional or global market, creating a negative reinforcing cycle. This is especially true in places where the majority of agricultural communities are highly economically vulnerable [80], which includes many Latin American and Southeast Asian economies (both members and non-members).

Long-term effects on smallholders, due to the interplay between price volatility and increased extreme climate events are varied, but most are expected to be negative. For example, smallholders often live as communities, so regional and even local extreme events are likely to affect entire communities [81,82], thus increasing the overall level of vulnerability in a region. In addition, there is a tendency of not investing in education and health care [83], and together with a tendency of either reducing consumption or liquidating assets to cover short-term deficits [84], the long-term social effects of climate-associated cumulative impacts lean heavily toward future poverty and lower food security.

In addition, economic and policy forces that push smallholders toward increased market integration tend to result in increased economic stratification, reduced crop diversity, and increased subjectivity to market volatility, thus leading to decreased resilience to climate change effects [85,86]. However, in highly isolated places (where access to markets was a historically limiting factor), increased connections with markets could increase smallholder resilience [87], since market access can minimize the effects of local climate shocks.

Climate and Smallholders

As outlined above, smallholders as a group are particularly vulnerable to the impacts of climate change. Such vulnerabilities arise from direct potential negative consequences of climate shocks as well as socioeconomic conditions that undermine the resilience that smallholder communities have historically relied upon to deal with environmental variability. What's more, due to the large numbers of people engaged in small- and medium-sized agriculture in many economies, the impacts of climate change, if they are not addressed in a manner suited to the economic context, will negatively affect large groups of the population. Such widespread negative impacts can lead to internal, and even international, migration and place strain on governmental institutions. In this way, it is imperative for such institutions to assess their institutional structures in order to assess whether the implications of climate change are sufficiently incorporated into governance at all levels.

PART II. Workshop

In order to achieve the objectives of the project, a workshop was held in order to document different experiences and recommendations as a result of and workshop *"Smallholders' Response to New Climate Scenarios Regarding Sustainable Water Use as a Contribution to Food Security."* The workshop facilitated dialogue about member economy government and local experiences, with plans and strategies to improve sustainable water use, address specific agricultural smallholder's issues, and enhance food security. One additional aim of the workshop was to gather recommendations and best practices in member economies that could be used to address main impacts of climate change on water security for smallholders.

Different methods of information-gathering were used to better capture the experiences and recommendations of APEC participants. A pre-workshop survey and a follow-up survey was applied to capture more specific information, complementing the shared experiences in the workshop.

The pre-survey was prepared and sent before the workshop. Its objective was to provide a first assessment about the change in food security and strategies, policies, and adaptive capacity for small-to-mid-sized farmers in APEC economies.

For the workshop, five working groups were each seated together, interacting and sharing experiences, first within each group and then shared with the other groups. After the workshop, a follow-up survey was sent to the representatives of the different economies to share experiences that were not discussed during the workshop. More details in the next sections.

Pre-workshop Survey Methodology

A digital survey was sent on 16.11.2017, to all the economies that confirmed attendance at the Seminar and Workshop. A Google form was used to conduct the survey, and the invitations to participate were sent by e-mail.

This questionnaire was expected to provide a first assessment of the impacts of climate change on food security in APEC economies and the current situation and experiences concerning strategies, policies, and adaptive capacities for small- and mid-sized farmers. This was done with a focus on sharing the best practices about efficient and sustainable water resources use.

A set of structured questions in three main sections were applied. The first section was oriented on the impacts of climate change in each respondent's economy. The objective of this section was to get a first approximation of the impacts on the APEC economies, in order to understand the main challenges that each would be facing and how important agriculture is in their economy. The three following questions were included in the first section of the survey:

1.- What are the most important effects of climate change on agriculture in your economy?

Justification of the question: The aim of this question was to better understand the main impacts of climate change from the APEC members point of view.

2.- What are the most significant impacts of climate change on the agricultural systems (livestock's, horticulture, cereals, among others) of your economy?

Justification of the question: The aim of this question was to understand the different impacts of climate change in different contexts and identify the challenges to achieve sustainable use of water, leading to better food security

3**.- What percentage of GDP corresponds to a small and medium- sized agriculture in your economy? How important is employment related to agriculture in your economy? Please define small – medium sized agriculture for your economy**

Justification of the question: This question aimed to understand and identify how relevant the small- and medium-sized agriculture are for the population in terms of livelihoods and their ability to generate employment, in relation to the percentage of GDP of each APEC economy.

A second section focused on strategies and policies to face climate change for small- and medium-sized agriculture, with the following question:

4.- What are the current actions and policies that your economy has implemented to ensure sustainable water use? Please refer to its performance, major gaps or problems the implementation

Justification of the question: This question aimed at better understanding different policy strategies that have been applied in the economies and how these strategies function as tools for water management and sustainable water use. It also could help evaluate the efficiency, gaps, and remaining problems.

The third section focused on climate risk management, with the following question:

5.- Which management mechanisms have your economy to prevent and react to emergencies due to extreme rain, floods or extreme droughts?

Justification of the question: This question aimed understanding how the economies are organized and prepared for an emergency. This answer may be directed to the adaptation capacity of each economy as they are directed to deal with extreme events.

Eight APEC economies[3] answered the survey (Annex I). The answers and interventions collected from the survey helped establish the different working groups, and address common challenges in the workshop.

Workshop methodology

The workshop took place in the Extension Center of the Pontificia Universidad Católica de Chile, Santiago, on 01.12.2017, in a 5-hour working day. Attendees were divided into 5 groups, with each group having 2 representatives from 3 different APEC economies[4].

The workshop was divided into two working modules and a final closing session. The first working module had a "top-down approach." Here, the different APEC members exchanged experiences related to policies and strategies to address climate change affecting smallholders at the economy government level. The second working module took a "bottom-up approach," with the focus on changing experiences to address sustainable use of water resources at the local level. This module was oriented to identify the main challenges and main practices to be taken to ensure sustainable water use.

To close the workshop, a review of the outcomes of each group was held were the 5 groups presented their shared experiences and recommendations.

[3] Indonesia, Malaysia's; Mexico; Papua New Guinea; Perú; Russia; Thailand and Viet Nam

[4] Group 1: Thailand; Perú and Chile, Group 2: Indonesia; Peru and Chile, Group 3: China; Mexico and Chile, Group 4: Russia; Malaysia and Chile and Group 5: Viet Nam; Canada and Chile.

The program for the workshop was as follows:

08:30—09: 00	REGISTRATION
09:00—10:15	FIRST MODULE WORKSHOP “TOP—DOWN” APPROACH
10:20—10:40	COFFEE BREAK
10:40—12:10	SECOND MODULE WORKSHOP “BOTTOM—DOWN” APPROACH
12:10—13:00	REVIEW OF THE OUTCOME OF THE WORKSHOPS
13:00—14:00	CLOSING SESSION AND COCKTAIL

In each group, there were assigned roles and responsibilities to guide and present the internal discussion with all workshop participants. Each group had an assigned moderator that had the role of guiding the discussion and a presenter whose role was to provide the main ideas from their working group to the rest of the groups during the review session.

Workshop Process

The groups were distributed in the workshop room, to improve the interaction among the members. For each person of the group, they had received a personal folder with the set of guiding questions and cards. Each group had a whiteboard with empty space to place their answers to each question. In these spaces, each of the economies represents, wrote down the main ideas of each guiding question and placed them in the assigned space. The answers were written on the provided cards to assist with subsequent data collection and collation. (For an explanation of workshop methodology, support material used, and the PowerPoint presentation, please refer to Annex II).

“Top-down approach” questions

1. - What are the current actions and policies that your economy has implemented for water management and sustainable water use? Please refer to its performance, major gaps, or implementations challenges

2. - What communication and coordination mechanisms are available in your economy to prevent and react to emergencies caused by extreme rains, floods, or extreme droughts?

“Bottom-up approach” questions

3. - What are the main challenges to ensure food security to adapt to the new climate change scenarios at the local level? Please focus on the roles of (a) smallholders, (b) research organizations, and (c) local governments.

4. -What are the main actions and best practices to be taken to adapt to climate change and ensure sustainable water use by smallholders? What are some successful local actions (technical, institutional, economic, etc.)?

Post-survey questions

A follow-up survey was send to all APEC workshop participants, to provide additional details and specific response mentioned during the workshop. This follow-up survey considers the same guiding questions from the workshop and provided an opportunity for workshop participants to provide more detailed information that would complement the answers they provided during the workshop.

PART III RESULTS

Responses to Pre-Survey Questions

Q1. What are the most important effects of climate change on agriculture in your economy?

Most economies indicated that water concerns were among the most important effects of climate change on agriculture in their economy, although the types of climate change impacts varied between them. The most common concern was changes in precipitation patterns, which was cited by Chile; Mexico; Indonesia; Papua New Guinea; Peru and Thailand. Changes in water availability and water scarcity was the next highest cited concern, being cited by Malaysia, Mexico, Peru, and Viet Nam. Peru also cited a concern about snowfall and frosts, given its strong reliance on Andean snowmelt for its water security.

However, impacts to water resources was not the only concern cited. Mexico indicated that a shortened growing season was a future concern to agriculture due to increased summertime high temperatures beyond plant and animal tolerances. Russia indicated the increase of extreme events, like the fires in 2010, which devastated major agricultural areas, and forced Russia to close its other outside markets. Viet Nam cited a concern about rising sea levels, given its many low-lying coastal territories.

In totality, these concerns cover much of the range of future concerns cited by scientific studies and reports. However, as somewhat indicated in the introduction materials, these reported climate change impacts on different territories will differ, based on the local and regional physical, economic, and political contexts. Some of these impacts were explored in the economies' responses to the second pre-survey question.

Q2. What are the most significant impacts of climate change on the agricultural systems (livestock, horticulture, cereals, among others) of your economy?

Each economy provided explanations of the impacts that climate change would have to them. Many impacts were related with changes in production yields caused by higher temperatures and increased climate variability. Here, we provide a summary of the reported impacts for each responding economy representative.

Mexico cited an expected increase in the numbers of pests and diseases, which would be a consequence of diminished winter severity, leading to greater chances of pathogen survival over winter. They also cited changes to the lengths of growing seasons, with increased temperatures leading to shorter growing seasons in traditional agricultural areas as temperatures become too extreme for both crops and livestock. As a consequence of higher temperatures, there is an expected increase in water demand, as evapotranspiration increases and livestock water demands increase for both hydration and cooling. Related to this, there is a concern that the crop quality would diminish, as would the economic value of the agricultural sector and the knock-on social effects in the areas affected by diminished agricultural value.

Viet Nam briefly cited concerns about the climate change impacts to horticulture and livestock sectors, but provided no further details.

Malaysia described how climate change would diminish agricultural yields. Specifically, prolonged droughts reducing water supply, especially in areas relying on rain-fed water supplies on the one hand. On the other hand, flooding would be detrimental to planting activities. The potential combined effects of regional flooding and drought could prove to be quite devastating to this multi-island economy.

Russia cited a number of negative impacts caused by climate change, which would have different impacts across the breadth of the economy. Namely, the disruption of climate stability would mean changing timings of planting and early autumn frost. In addition, changes in the precipitation regime would mean that certain areas would experience more drought or flooding, which would significantly alter the soil condition and the agricultural practices throughout entire regions. Increased temperatures would also increase the likelihood of disease and pest outbreaks and the intensity of breeding by pest organisms.

Indonesia indicated that climate change impacts would affect food production systems by causing lower yields, which would mean that they would not meet economic production targets. The expected precipitation changes described were inadequate rainfall causing isolated and short- to medium-term droughts; variable onset of the rainy season, which would disrupt planting and sowing, leading to potential crop failure, seed loss, and lost harvests; and more intense rainfall, which would cause flooding and water-logging croplands.

Peru described how climate change would alter agricultural calendars, significantly altering production planning, causing direct losses due to mortality and morbidity, and diminishing system performance. Fruit trees were cited as being particularly vulnerable. Climate change was also described as guiding technical assistance policy to mitigate short-term impacts through the Disaster Risk Law and longer-term impacts through programs in the National Institute of Agricultural Research. Climate change is recognized as producing economic losses and also increasing food security risks, and a feeling by the rural population of greater vulnerability and increased migration to cities.

In Chile, that has different climates across the territoryhas different concerns. In the case of north Chile, longer dry seasons are going to affect directly in the production capacity. Also, more intense precipitations can increase floods risk disasters. This affects directly to smallholders. For central Chile, a decrease of precipitations threat the amount of water storage in dams, for the dry season (central Chile has a Mediterranean climate, this means that there's no rain in summer, the dry season), reducing the cultivable area.

Understanding how much these impacts would have on each economy overall, and to smallholders specifically, was answered in the third pre-survey question.

Q3. What percentage of GDP corresponds to a small- and medium-sized agriculture in your economy? How important is employment related to agriculture in your economy? Please define small- and medium-sized agriculture for your economy.

Overall, the percentage of GDP made up by agriculture was relatively high among most economies. The reported values, from lowest percent of GDP to highest, were Malaysia (2.4%), Mexico (4%), Peru (6%), Thailand (9%), Viet Nam (16.32%), and Papua New Guinea (26%). Within these agricultural sectors, the impact of smallholders and medium-sized operations were all quite substantial. For example, in Malaysia, this group contributes to 11.2% of the agricultural share of GDP. In Papua New Guinea, roughly 80% of the economy population are smallholders or live in rural villages, closely associated with small-scale productive activities. In Peru, 99.3% of all agricultural units were small- and medium-sized operations, and this group produces aporximate, 20% of the agricultural share of GDP, and involves roughly 25% of the economy workforce. In Viet Nam, small- and medium-sized operations make up 99% of all enterprises. Finally, in Thailand, roughly, smallholders produces the 80% of the economy´s agriculture.

As indicated in the introduction, the definition of “smallholder” varied across economies, with some definitions being based on economic value, others based on property size, and others including characteristics of agricultural practice. In a number of economies, smallholders were combined with medium-sized agricultural operators. In Malaysia, small and medium agricultural operators were defined as those not exceeding RM20[5] million and no more than 75 full-time employees. In Papua New Guinea, smallholders is defined as those cultivating heirloom seeds on land areas between 0.12 to 0.36 hectares using family labor, simple tools, and traditional planting materials, while also using no fertilizers, pesticides, or imported seeds. In Peru, smallholders are defined as those managing 1 to 5 hectares of land for agriculture, livestock, and/or agroforestry. In Thailand, smallholders are defined as having land areas less than 1.6 hectares. Finally, in Mexico, smallholders are defined quite generally as being people with limited access to land and financial resources, who pursue productive activities primarily through the use of family labor. [6]

Q4. What are the current actions and policies that your economy has implemented to ensure sustainable water use? Please refer to its performance, major gaps or problems the implementation

The responses from the different economies provided varying levels of description to current actions and policies that have been implemented to ensure sustainable water use. Since each economy’s approach is necessarily different in the details of how policy instruments operate, the responses from each economy are presented in order to show the breadth of approaches being used across the region.

[5] RM means Malaysian ringgit, the official Malaysian coin
[6] Note: Russia and Indonesia did not provide responses to this question.

In Mexico, policies have tried to promote the implementation of precision agriculture management, integrated Pest Management, automated irrigation systems connected to automated weather stations, three-month forecasts updated daily, and 120-hour forecasts updated daily. Major challenges remain in coverage, maintenance, and storage capacity.

In Malaysia, irrigative water supplies are currently adequate, but during El Niño and other extreme events, smallholders struggle to meet water needs, due to lack of water distribution infrastructure. In such cases, farmers have resorted to using of tube wells, but the government continuously invests in infrastructure improvement and is conducting research to optimize sectorial water use. In addition, governmental credit or grants are sometimes given as one-off payments to provide investment incentives.

Russia reported on their robust and broad institutional structure that helps manage water use and water security for sustainable water use. Specifically, the Ministry of Agriculture drafts and implements policy and regulation in agriculture and related industries, including the sustainable development of rural areas. It is also in charge of policy and regulation of farmland, monitoring such lands, and providing state agricultural services, including the extension services supporting sustainable resource use. In comparison, the Ministry of Natural Resources and Environment is in charge of policy and regulation in the renewal and conservation of natural resources, including lakes and rivers, coordinating the activities of the Federal Hydrometeorology and Environmental Monitoring Service and the Federal Water Resources Agency. The Federal Water Resources Agency specifically organizes the redistribution of federal water resources, organizes the development and realization of basin agreements to restore and conserve water bodies, organizes flood-control measures, and establishes water protection zones. Finally, the Russian Association for Water and Wastewater represents the consolidated position of the professional community of water industry in the public authorities, participates in the development of sectoral legislation, improve legal frameworks, assists in developing and implementing innovative energy-efficient technologies in the water sector, organizes scientific-practical gatherings, and actively participates in international and domestic industry events.

In a similar vein to Russia's response, Peru provided several member economy government laws, policies, and action plans that are related to water conservation. The member economy government Policy on Water Resources and the National Water Authority (ANA), prioritize integrated water management, water use culture, investments, funding and hydraulic infrastructure, among others. The Water Resources Law regulates water use, the actions of the State and stakeholders, and assets associated with water. One major on-the-ground action plan in the high Andes is the "Sierra Azul Fund," which funds the construction of micro-reservoirs across the length of the territory to assist with collecting and harvesting water to assist with water security in the highlands. Also, Peru's agricultural policy is focused on increasing the amount of irrigation infrastructure for small- and medium-sized agricultural operations in the mountain and rainforest regions of the territory. However, a continuing challenge lies in limited implementation and insufficient budgets to achieve the program goals.

Indonesia highlighted water conservation actions of infrastructure development. Specifically, the constructions of dams, reservoirs, and connected irrigation systems. These irrigation channels are powered by pumps to ensure that fields have adequate water to grow cereals in paddies. These operations were described as being successful in 2016 and 2017 in ensuring sufficient cereal production in paddies.

Although there are currently no specific policies or action plans in the area of water-use and management for agriculture, horticulture, or livestock management, Papua New Guinea described the broader goals of current economic and agricultural policies and action plans. These include increasing and improving the productivity and farm outputs of main food staples, horticulture, small livestock, and fish-farming, as well as increasing the efficiencies of the entire food value-chain. It also focuses on building stability and resilience into food production and supply systems and enhancing the nutrient content of foods. Finally, the policies include strong social and governance aspects, namely empowering women in agriculture, since most food and home gardening is done by women, and strengthening government coordination, monitoring, and policy communication with stakeholders. Actual strategies and policies for intervention using sustainable water use or its control/management in flooded or seasonally inundated areas are not yet established, due to a lack of human resource capacity and funding sources for major sustainable water use and management projects.

Viet Nam focused on development and implementation of integrated management strategies and strengthening of regional and member´s economy government co-operation in managing water resources management. This focus on water management stems from the understanding that the economy shares much of its freshwater resources with neighboring economies, which makes questions of water security tightly connected with those of international relations as well as domestic planning concerns.

In the case of Chile, are actually implementing the National Adaptation Plan, that gives the guidelines for adaptation in the territory. Also has a National Adaptation Plan of the agronomic and forestry sector. Also has accumulation reservoirs plan, focus on smallholders, that foments efficient use of water and incorporation of new irrigation technology in order to support smallholders against climate change.

Finally, Thailand focused on the Strategic Committee for Water Resource Management (SCWRM), that was created in 2011. This body formulated the master plan for sustainable water resource management, with the objectives of preventing and minimizing losses and damages from medium and large floods, improving the flood prevention system's capacity, and building social confidence and stability while increasing farm, community, and member economy government incomes through natural resource management. Another measure to improve water and food security was the recent increase in irrigated areas as part of Roya Irrigation Department activities.

Q5. What management mechanisms does your economy have to prevent and react to emergencies caused by extreme rain, floods, or extreme droughts?

As with the responses to the previous questions about the responses by individual economies, the variety of identified mechanisms by different participants was quite broad. Therefore, summarizations of responses for each economy are provided.

Mexico identified prevention, with monitoring being the key to prevent economic damage caused by natural disasters.

Viet Nam indicated that emergency preparedness was important. Here, disaster response plans, with public awareness campaigns and communication being important.

Malaysia described how the budget of the flood prevention program was increased every year, and the cumulative impact of infrastructure development may provide benefits to the agricultural sector, especially areas in or near urban areas. Simultaneously, research into the development of drought-tolerant varieties is a priority for future food security.

Russia focused on policies related to increasing forested areas. Russia is trying to create favorable conditions for forest development. In 2013, its forest policy started modernizing forest management and increasing forest quality. An automated information system for registration of wood and deals with it was created. The system currently contains more than 3 million documents on contracts, information on declared and actual wood harvest volumes, and information on all timber transactions are provided.

Indonesia looked at drought prevention in paddy fields through its policy of water infrastructure development, as described above in their response to question 4.

Papua New Guinea identified a management mechanism utilized following recent localized droughts, heavy rainfall, and massive flooding in the different farming regions. The mechanism supplied affected rural communities with emergency food aid, drinking water, medicine, temporary shelter, and new garden planting materials and seeds to reestablish food gardens. No interventions and very little assistance in terms of major sustainable water projects, water drainage and control projects, for and smallholders to protect crops, livestock, and enterprises from failure due the extremes of the floods and droughts have been given or seen over recent years in most farming communities that have been experienced drought, flooding, and crop failures. Papua New Guinea has abundant water sources, but these sources are yet to be utilized using modern irrigation and water control technologies. There are currently no major investments in sustainable water use technologies and their application to farming, agriculture, horticulture, or pasture production, due to a lack of policy direction aimed at sustainable water use.

In Peru, the Agrarian Policy Guidelines mention prevention and risk management with the objectives of improving and expanding prevention and assistance to farmers at the highest risk of droughts, floods, or frosts caused by climate change. The objectives are implemented through protecting water infrastructure, river-channeling programs, and promoting stakeholders with capabilities in disaster risk management. In the case of excessive rain, river channels are cleared and dams are used for downstream defense, as is reforestation activities. Livestock deworming programs are also initiated. In the case of droughts, irrigation canals and small reservoirs are constructed. Hay bales, supplemental feed, and the installation of cultivated pastures are initiated for livestock in the area.

Chile, has three tools to manage emergency, the first is the agriculture emergency decree, water emergency decree and catastrophic zone decree. These tools may release public resources from many ministry's. In the case of water emergency decree, can re-distribute the water in a basin in the case of emergency, in the case of agricultural emergency, can designate resource of many public institutes of Ministry of Agriculture, and for last, the catastrophic zone decree allows to use two percent (2%) of budget of Chile.

In Thailand, extreme rains, floods, and droughts are managed through the Royal Irrigation Department and the Department of Disaster Prevention and Mitigation. In addition, agricultural water security is currently being addressed through the Ministry of Agriculture and Cooperatives through its Smart Water Operation Center, which is linking all relevant water resource management agencies during drought and flooding crises. The Center also serves as a public relations center to handle information management from all agencies involved, thus improving inter-agency communications and helping achieve smoother governance. Moreover, through the Smart Water Operation Center, relevant agencies can assist farmers in the short- and long-term in order to reduce damage from water-related disasters. Farmers can use the services from the Center to plan their agricultural production according to the water situation.

Workshop Responses

During the workshop and through the responses to the follow-up survey, the responses provided by participants of the workshop helped provide a picture of the breadth of policy options and governmental institutions available (top-down), as well as roles of local actors and institutions, sets of best practices, and examples of success (bottom-up) related to questions of water and food security faced by smallholders. There were some general key topics that became apparent from the responses provided by participants:

1. Governments are aware that climate change will significantly impact water security, and they are taking measures to address these concerns, often through integrated water resource management approaches,

2. Governments are relying on already existing emergency management agencies to respond to acute weather extreme events caused by climate change,

3. Smallholders have the responsibility to implement behavioral changes in their agricultural practices; research organizations have an obligation to disseminate useful information on climate adaptation through extension services; and local governments have the responsibility of either funding local projects or providing opportunities for improving food security,

4. There is no single set of best practices, and there are many examples of success.

The current position finds APEC economies well in a period of transition to a new paradigm of climate-change preparedness through investments in infrastructure improvements, the implementation of climate change resilience and adaptation policies, and attempts to ensure that such changes are reaching smallholders.

Due to the knowledge limitations of the participants on all aspects of governmental policy at various levels, the role and functioning of different institutions, and the collective lived experiences and needs of smallholders, the responses provided during the workshop can be said to only represent the understandings and awareness of the participants. As such, we are not proposing that these results are to be used as a definitive guide to all the ways in which the questions posed during the workshop could be answered. Such a task could easily fill a volume of information for each participating economy. Instead, what we present is a synthesis of responses held in common across economies, as presented by participants who each had a solid and well-grounded understanding of the contexts of their own economies.

All participants were provided with an opportunity to provide supplemental information for the responses given during the workshop, and the majority of participating economies did send additional information. However, very little substantive changes were provided in the follow-up survey; the vast majority of the responses were clarifying or providing associated information to the points provided during the workshop. The lack of any major correction or substantive addition to the information gives us more certainty as to the responses provided during the workshop.

This section contains the responses received from economies regarding the responsible organizations in their economies for water resource management or agricultural ministry.

Top-down Approach

Q1. What are the current actions and policies that your economy has implemented for water management and sustainable water use? Please refer to its performance, major gaps, or implementation challenges.

Across most economies, there was a consensus that integrated water resource management (IWRM) was an optimal mechanism for developing and implementing sustainable water use and water management. The particular methods in which these have been – and are being – implemented varied across economies, though. Most often, the IWRM principles are to be implemented though various legal mechanisms, such as in Indonesia, Malaysia, México, Peru, Thailand and Viet Nam.

In the case of Perú, for example, where such principles are found in the National Water Resources Policy (Policy 33), the Water Resources Law (Law #29338), the Risk Management and Adaptation to Climate Change Plan for the Agrarian Sector GRACC (by its acronyms in Spanish) and the National Agricultural Policy. In this way, existing governance structures and mechanisms can be used to implement water security policy to cope sustainable water use.

In Thailand, a Strategic Committee for Water Resource Management (SCWRM) has been implemented, to formulate the master plan on sustainable water resource management to ensure the continuity of economy´s development. The objective of this strategy is preventing and minimizing losses and damages from medium to large scale flood, improve the capacity of flood prevention system and build confidence and stability and increase farmer, community, and member economy government income while managing water, land and forest for sustainable utilization.

In Malaysia, the IWRM, is linked to various initiatives such as: Integrated Lake Basin Management; Integrated Aquifer Systems Management; Water Demand Management; Climate Change and Water; Water Supply and Wastewater Management; Integrated River Basin Management and Agriculture Water Services for Agribusiness, comprising water and land use, flood and drought management, which aimed to strengthen the management of water resources in the territory.

One consistent key aspect in how water and food security initiatives were implemented at the level of the smallholder was through the construction and improvements of water distribution systems, both through expanded coverage, but also through investments in irrigation technology.

For example, in Indonesia, some of the current actions by the government have focused on rehabilitating existing irrigation systems through improvements in reservoirs and canals; constructing new reservoirs and irrigation networks; and developing small-scale water irrigation by building small weirs and reservoirs. Similarly, in Peru, the “Sierra Azul” (“Blue Mountains”) program has helped small-scale water harvesting throughout the Andes through community programs to construct micro-reservoirs to improve water security and assist the smallholders living in the Andean Highlands.

Another popular policy option is the development of training programs, often through agricultural extensions, to assist with farmers and water users – including smallholders – in dealing with the expected impacts of climate change.

Some unusual solutions for improving water management and water security were also presented. These included technological solutions to assist smallholders and the use of negative economic incentives. For example, in the case of Mexico, they have implemented a web app for phones covering the entire territory. In this App, users can find forecast weather in a short term and information in web page, were users can find irrigation recommendations information, Evapotranspiration information and over 23 crop water need.

In the case of China, the use of negative economic incentives, like the current tax of water resources in order to move towards to water conservation, this is part of the Action on promoting agri-water conservation and an action plan for coping with climate change in agriculture (water conservation program and action plan for coping to climate change are initiatives from the Ministry of Agriculture). As part of this plans, a water rights reform was implemented in order to promote efficient use and better management. In the other side, the Water Resource Ministry develop a “Eleventh Five-year Plan of Water-conserving Society Construction”.

In the case of Chile, there are strategies and laws to improve water and water storage capacity to face climate change. For one side, the National Plan for Adaptation to Climate Change (2014), provides the guidelines for sectoral adaptation plans, which are currently in the implementation or design phase. The National Plan for Adaptation to Climate Change has four transversal action, being; scientific research, environmental communication and educations, institutional strengthening and reduction of risk disaster. For each of these transversal actions there are main actions that cover transversally sustainable management of water in several these actions.

There also is a sectorial adaptation plan for forestry and farming focus in 5 mains guidelines, being this, improving the competitiveness of Agriculture; promoting research and innovation; promoting economic, social and environmental sustainability; transparency and access to markets. All these guidelines have a total of 21 actions, in process of being implemented. For example, one of these adaptation actions are, the implementation of rainwater harvesting system for irrigation and drinking, Development of new silvicultural methods that allow facing Climate Change among others. In other hand, there is the Irrigation and drainage law (ley 18.450), that subsidizes the implementation of know technology for irrigation for farmers.

Q2. What communication and coordination mechanisms are available in your economy to prevent and react to emergencies caused by extreme rains, floods, or extreme droughts?

All participating members provided examples of various government agencies involved with responding to emergencies caused by extreme weather events. Few participants provided information about disaster prevention, but there were a number of examples of the development of risk-management plans.

One of the general findings is that most governmental mechanisms set up to respond to extreme events were already existing agencies and departments. Some were noted as specifically being tasked with developing plans to address climatic change adaptation, for example the GRACC from Perú, in Chile the National Policy of risk Management. Many participants provided examples of specific agencies or groups of agencies that were in charge of managing conditions during extreme events, indicating that the various means by which disasters are managed in different economies. For example, most economies rely on a single agency, for example, Chile has the National Emergency Office (ONEMI, by its Spanish acronym) an institution hosted in the Ministry of the interior and public security. This agency has the role and labor of the coordination of the National Civil Protection System. Its mission is to plan, promote, articulate and execute prevention, response and rehabilitation actions in the face of situations of collective risk, emergencies, disasters and catastrophes of natural origin or caused by human action. The ONEMI institution is in charge of operating and carry out the “National Risk Reduction Management Policy” in the framework of the Sendai, this policy gives the guidelines to manage risk.

In Peru, The National Institute of Civil Defense who is technical responsible institution for coordinating, facilitating and supervising the formulation and implementation of the National Policy and the National Disaster Risk Management Plan, in the preparation, response and rehabilitation processes. In Thailand, the Department of Disaster Prevention and Mitigation[7] under Ministry of Interior (MOI) to handle disaster management responsibilities., that aims to have a better and more effective mechanism to prevent disaster damage and loss and to mitigate calamity due to man-made and natural disasters.

[7] http://www.disaster.go.th/en/

In Indonesia has the Indonesia's National Disaster Management Authority (Badan Nasional Penanggulangan Bencana in Indonesian), the role of this institutions is to prevent and reduce disaster risk and, at the same time, ensure that disaster risk management becomes a shared responsibility of central and local governments [88]. Other economies have various layers of disaster management, based on government structures. For example, in Canada, the federal and provincial levels each administer disaster relief agencies, which would coordinate efforts.

Although all participants could provide examples of government institutions involved with disaster management, few participants provided information about how existing disaster management agencies were equipped and coordinated to handle climate change.

Few participants provided examples of available policy options for medium- and long-term responses to extreme events. It was noted that Chile has plans for drought management, Similarly, it was noted that Chile has AgroSeguro[8], which provides insurance instrument to farmers which allow transferring economic losses caused by damage to an insured crop, due to weather phenomena covered by the policy and fluctuations in the price of agricultural commodities that farmers in the sector face.

The governmental response to disaster relief generally exists as one or a few agencies, whose major purpose is disaster management. Often, such a concentration of governmental response is exactly what is necessary when responding to a disaster, since it permits streamlining decision-making at a time when rapid responses to changing situations is crucial. However, in the economy territory in iresponse planning to increased frequencies of extreme weather events caused by climate change will likely require an assessment of emergency response strategies within economies, if it has not yet been done.

[8] https://www.minagri.gob.cl/institucion/agroseguros/

Importantly for smallholders – who are often situated in more marginal contexts, both economically and geographically – ensuring that emergency management agencies are sufficiently equipped to provide relief services to smallholders will be important. Many smallholders live in small communities that do not have direct access to emergency services, and when extreme and acute weather events occur – such as hurricanes, fires, or floods – it can often affect entire communities, instead of a few large agricultural properties. Ensuring that economies develop robust climate change risk management strategies that connect all the territory of the economy, regional, and local planning and response to smallholders is a crucial aspect in minimizing exposure to climate risk. Such responses could take the form of economic risk management through insurance programs, to provide assistance to smallholders in the medium term.

Bottom-up Approach

Q3. What are the main challenges to ensure food security to adapt to the new climate change scenarios at the local level? Please focus on the roles of (a) smallholders, (b) research organizations, and (c) local governments.

In general, the participants' responses for the types of actions that each identified group should provide followed very similar patterns. Smallholders needed to engage in behavioral change in their practices, research organizations needed to provide extension services and actionable information, and local governments should provide support – either directly or indirectly – to maximize the opportunities in to connect education with practice. These responses fit well into the expected roles played by each of the identified groups, and may speak to the inherent assumptions and perspectives held by the participants. Here, we will examine the breadth of responses, looking at the challenges faced by each of the identified groups.

The types of challenges that participants identified for smallholders were based around behavior and behavior-change. One challenge identified for smallholders by nearly all participants is the need to learn how to modify their practices to adapt to the impacts of climate change. This -challenge potentially places a burden on the smallholder to seek out extension services or other educational services in order to learn about the implications of climate change in the area operated by the smallholder and for the types of agricultural activities the smallholder pursues.

Participants overwhelmingly noted that research organizations should ensure that they provide extension services and impactful information to smallholder farmers. This generally meant that research organizations should work on developing new technologies or understandings of agricultural practice that would promote sustained water security and food security. Furthermore, these techniques and understandings can be disseminated through extension programs to smallholders. Also, one of the major gaps identify where knowledge transfers between researchers and policy makers, and the way that decision makers uptake this information and knowledge in a useful way.

Finally, in the area of local government, most participants identified different strategies in which local governments could help provide opportunities. This could be through direct investment, in irrigation technology for smallholders, educational opportunities for smallholders, technology development for research organizations, or in leveraging funds through local contacts to develop ideas. Some more novel ideas were provided, though. These include from; promote the culture of prevention and adaptation to climate change by training communities of small farmers and financing food security projects. Specific programs such as extension programs to strengthen capacities, or awareness to save water improves the quality of the river. Carry out field programs on adaptation to the impacts of climate change, land degradation, desertification and drought. In particular, adaptation measures for the conservation of vegetation in watersheds, these conversation measures provide essential ecosystem services, which greatly contribute to the adaptation to climate change.

While the participant responses generally tended toward the traditionally described roles for each group, this type of response itself is not surprising, since the food security questions facing smallholders tend to change, based on what particular region one is discussing. For example, the types of food security questions in Indonesia will be different, based on whether the context is on the main island of Java, versus one of the smaller, more remote islands. The types of responses that have been identified by participants do speak, however, to the general perceived trends associated with using existing social and governance infrastructure to provide information and incentives to farmers in general – including smallholders.

One thing that is clear is that for extension programs to function well, they require community buy-in. Conversely, in a case of future planning for climate change to encompass all types of farmers – from large operations to smallholders – extension services will need to examine the efficacy of their services in reaching different sectors of society. Conducting such an evaluation of the level of dissemination and use of their services will help highlight the areas that are less well-served, and – together with local government and social institutions – develop plans to assist with knowledge and technical dissemination. A part of such an assessment is determining the knowledge level and perceptions that smallholders – and other farmers – have about the potential impacts of climate change in the area local to the farmers. Similarly, extension programs could examine the efficacy of traditional knowledge in addressing some of the expected climate impacts and determine ways in which these systems of knowledge can be appropriately adapted, technically and culturally.

Q4. What are the main actions and best practices to be taken to adapt to climate change and ensure sustainable water use by smallholders? What are some successful local actions (technical, institutional, economic, etc.)?

When asked to provide examples of best practices and successful local actions, the participants provided a very diverse set of responses. Here, there was little consensus beyond the generally applicable example of smallholders improving water distribution and/or storage systems, which was identified by nearly all participants. Beyond this broad point of consensus, the suggestions for best practices were broad, and the types of examples were even broader.

Although the workshop responses generated a plethora of suggestions, there was a slight tendency toward a few types of management practices associated with water conservation. Following the suggestion of improving water infrastructure, the most suggested best practices (suggested by three or more economies) were the use of water conservation laws, soil conservation, crop selection to match climate conditions, seasonal forecasting, working with farmers to determine best water practices, and reforestation.

Other examples of best practices included implementing market strategies, payments for ecosystem services, development and dissemination of a mobile app for agricultural planning, the use of traditional knowledge, pursuing institutional reform, focusing on aquifer recharge, and implementing watershed-based resource management.

In general, these suggested management practices tend to be at scales that are best suited to actions of government or (in the case of crop selection and best water practices) research organizations. In other words, a lot of the examples for management practices were focused on a top-down approach. Only Peru provided fleshed-out examples of smallholder water management successes, which incorporated a more bottom-up approach. In the Sierra Azul Program, water sowing and harvesting actions have been implemented at the headwaters of highland Andean basins throughout Peru through the construction of micro-reservoirs for water retention that will be used in agriculture and livestock. Although funding for the program is from the government, the planning and construction of micro reservoirs is undertaken by local communities.

The Rural Agricultural Productive Development Program in Peru focuses on micro basin management. In the upper part, reforestation of hillslopes with native species is being done, along with rational management of native pastures through pasture division with livestock meshes, complemented with infiltration ditches and grazing. In the middle basin, soil management is carried through the construction of infiltration ditches for afforestation, the rehabilitation of pre-Hispanic agricultural terraces, and the implementation of agroforestry. Agricultural activities focus on growing crops with low water requirements. Pastoral activities focus on breeding species with the capacity to resist adverse climatic phenomena, such as the alpacas and sheep.

Another Chilean adaptation pilot, is the "Rainwater harvest to address impacts of climate change in rainfall regime[9]" in Region de Los Ríos, Chile. This location suffers from problems of water scarcity in summer and has been supplied for years by the Municipality with water brought by tank trucks (1,000 liters per week, 1 cubic meter). In this first pilot experience, its has been a successful experience, it has been a tremendous help to the people, because they were living almost without water.

[9] http://www.forestal.uach.cl/noticias/post.php?s=2016-11-25-instalan-sistema-de-captacion-de-aguas-lluvias-en-zonas-rurales-de-la-region-de-los-rios

CONCLUSIONS

The APEC economies are in a phase of preparing and implementing actions and/or public policies towards improving the efficiency of water use. Although it is one of the main factors affecting food security, there are complex social and economic problems that condition the resource distribution, which then affect food security.

Three major GAPS were identified, at economy level and locally, which can be classified as (1) a lack of funding for adaptation initiatives, such as sustainable water management, (2) a lack of knowledge, regarding information gaps for knowledge construction, as well as the transfer of this knowledge to decision-makers, and (3) a lack of technologies to improve the efficiency of different processes, such as local adaptation measures. Often, though these gaps are usually linked, and are not independent factors.

One key aspect shared by the economies was not enough clear communication between government, research institutions, and water users. This has meant that there are problems in implementing and maintaining policies and actions on the ground and an unclear idea of what local users need. This problem is associated with a lack of funding to implement and maintain adaptation actions, as well as a lack in knowledge transfer. Some economies have indicated plans and actions to tackle different aspects of this communication and knowledge-transfer problem. China’s delegation described methods by which different agencies have tried to work together to streamline interagency communications.

Another key aspect was associated with how to provide incentives to farmers so that water resources are utilized in a sustainable manner; to avoid "tragedy of the commons" types of problems. Some measures, like the Sierra Azul initiative, utilized community effort to create intrinsic communal value in the resource. Others have sought to provide water users with subsidies, which would then require water users to invest their own funds into the project, fostering a sense of ownership. However, the “tragedy of the commons” problem will remain a concern that member economies will have to consider into the future.

A final key aspect associated across many economies is the continued gaps in technical expertise, due to a lack of trained personnel, a lack of regional and local models, or a lack of technical capacity. Although the gaps were not the same across economies, the delegates all understood the importance of responding to them, especially due to the approaching impacts from climate change. Furthermore, delegates understood the importance of working to fill these gaps in order to assist smallholders determine the types of actions that would help them avoid some of the worst impacts from climate change, since it was understood by everyone the major presence that smallholders have within many of the economies.

RECOMENDATIONS

The following recommendations were taken from the experiences exchange from the workshop and the information gathered from their different surveys and complemented by literature.

In both top-down and bottom-up approaches, there are gaps that must be considered to achieve the sustainable use of water and ensure food security for smallholders, and with information and knowledge gathered in both; top-down approach and the bottom-up approach, there were identified tree gaps categories, (1) funding gap, (2) knowledge gap and (3) technology gap.

These main gaps are also found in a conceptual framework by the *Adaptation Gap report* of the UNEP. This report defines the adaptation financing gap (funding gap) as the difference between the costs of meeting a given adaptation target and the amount of finance available to do so (UNEP, 2014). In most of the experiences given by the economies, we identified cases where financial for adaptation actions were needed. For example, in In Malaysia, the lack of water distribution infrastructure directly impacts smallholders, particularly in the “battle” to meet water needs during El Niño. Failure in infrastructure brings higher costs at the time of repairing the damage and subsidizing smallholders to recover what was lost. In these cases, the lack of investment will surely be less than that spent on repairing damages. Empowered decision makers are key to moving towards greater success of adaptation initiatives. The methods, tools and outputs of the UK Climate Impacts Program (UKCIP) show how adaptive capacity to climate change can be embedded within a wide range of organizations [89].

Another issue that may concern different economies, for example, plans and laws lead to the financial weight that the economy must maintain for the implementation plan. For underdeveloped economies, this financial gap is crucial, for the implementation of new technology that makes the process more efficient, economies must plan efficiently, reduce the risk of maladjustment, bringing higher costs [90]. A common recommendation for smallholders is the implementation of agricultural insurance for the most vulnerable population. This type of policies reduces the sensibility of smallholders to the main climate change impacts [91].

The adaptation knowledge gap is defined as the difference between the costs of meeting a given adaptation target and the amount of finance available to do so. Many gaps can be identified from the shared experiences, for example, in a top-down approach, there is a lack of scientific information to make decisions, in order to have a better understanding of the regional and local impacts, with robust results. Without accurate information, undesired strategies (maladaptation) can be adopted. Ideally, strengthening the knowledge on the impacts of climate change, help select better adaptation strategies. In this way, those responsible for policies and decision-making can improve the decision-making process. Another example is to facilitate the search for new crop varieties that are better adapted to future changes such as crop resistant to drought, frost, among others.

Another knowledge gap, is the transfer of the knowledge in a usable way for decision makers and then transfer this information in a good way to stallholders, in a way that they uptake this information and use it to cope with adverse effects of their environment will. There still a knowledge gap from bottom up approaches that has not been given enough importance, that is the use of traditional knowledge. This type of knowledge might strengthen capabilities of smallholders.

The adaptation technology gap can be defined in terms of perceived gaps by economies, based on available technology needs assessments and requests made to technology support mechanisms. Some of the economies are improving on technology use, for example Mexico counts with mobile apps for phones, online weather forecast, accessible for smallholders, it also has seasonal forecast, so farmers can anticipate for the next crop.

REFERENCES

1. Rapsomanikis G. The economic lives of smallholder farmers: An analysis based on household data from nine countries. Rome; 2015. doi:10.1016/j.rausp.2016.10.004
2. Hoppe RA. Structure and finances of US farms: Family farm report , 2014 Edition. 2014. doi:http://hdl.handle.net/10113/22839
3. Robiglio V. Fact sheet: Assessing Smallholder Farmers and Forest Dynamics in the Peruvian Amazon. Bogota; 2014.
4. Lipton M. Crop Science and the Family Farm in a Globalising World. New Dir a Divers planet. 2004; 1–18.
5. Pope RD, Prescott R. Diversification in Relation to Farm Size and Other Socioeconomic Characteristics. Am J Agric Econ. 1980;62: 554. doi:10.2307/1240214
6. Ellis F. The Determinants of Rural Livelihood Diversification i n Developing Countries. J Agric Econ. 2000;51: 289–302. doi:10.1111/j.1477-9552.2000.tb01229.x
7. Lamb RL. Inverse productivity: Land quality, labor markets, and measurement error. J Dev Econ. 2003;71: 71–95. doi:10.1016/S0304-3878(02)00134-7
8. Carletto C, Savastano S, Zezza A. Fact or artifact: The impact of measurement errors on the farm size–productivity relationship. J Dev Econ. 2013;103: 254–261. doi:10.1016/j.jdeveco.2013.03.004
9. Eakin H. The social vulnerability of irrigated vegetable farming households in Central Puebla. J Environ Dev. 2003;12: 414–429. doi:10.1177/1070496503257733
10. Moench M, Dixit A. Adaptive Capacity and Livelihood Resilience: Adaptive Strategies for Responding to Floods and Droughts in South Asia. Boulder, CO; 2004.
11. López-i-Gelats F, Fraser EDG, Morton JF, Rivera-Ferre MG. What drives the vulnerability

of pastoralists to global environmental change? A qualitative meta-analysis. Glob Environ Chang. 2016;39: 258–274. doi:10.1016/j.gloenvcha.2016.05.011

12. Morton JF. The impact of climate change on smallholder and subsistence agriculture. Proc Natl Acad Sci. 2007;104: 19680–19685. doi:10.1073/pnas.0701855104

13. IPCC. IPCC 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. 2014. doi:10.1017/CBO9781107415324

14. Crawford SS, Muir AM. Global introductions of salmon and trout in the genus Oncorhynchus: 1870-2007. Rev Fish Biol Fish. 2008;18: 313–344. doi:10.1007/s11160-007-9079-1

15. IPCC Working Group 1. IPCC Fifth Assessment Report (AR5) - The physical science basis. IPCC. 2014. doi:10.1017/CBO9781107415324.004

16. Schewe J, Heinke J, Gerten D, Haddeland I, Arnell NW, Clark DB, et al. Multimodel assessment of water scarcity under climate change. Proc Natl Acad Sci. 2014;111: 3245–3250. doi:10.1073/pnas.1222460110

17. Döll P. Vulnerability to the impact of climate change on renewable groundwater resources: a global-scale assessment. Environ Res Lett. 2009;4: 35006. doi:10.1088/1748-9326/4/3/035006

18. Hirabayashi Y, Mahendran R, Koirala S, Konoshima L, Yamazaki D, Watanabe S, et al. Global flood risk under climate change. Nat Clim Chang. 2013;3: 816–821. doi:10.1038/nclimate1911

19. Basher, L., Douglas, G., Elliott, S., Hughes, A., Jones, H., McIvor, I., Page, M., Rosser, B., & Tait A. Impacts of climate change on erosion and erosion control methods – A critical

review. 2012.

20. Champathong A, Komori D, Kiguchi M, Sukhapunnaphan T, Oki T, Nakaegawa T. Future projection of mean river discharge climatology for the Chao Phraya River basin. Hydrol Res Lett. 2013;7: 36–41. doi:10.3178/hrl.7.36

21. Wada Y, Wisser D, Eisner S, Flörke M, Gerten D, Haddeland I, et al. Multimodel projections and uncertainties of irrigation water demand under climate change. Geophys Res Lett. 2013;40: 4626–4632. doi:10.1002/grl.50686

22. Xiong W, Holman I, Lin E, Conway D, Jiang J, Xu Y, et al. Climate change, water availability and future cereal production in China. Agric Ecosyst Environ. 2010;135: 58–69. doi:10.1016/j.agee.2009.08.015

23. Gerten D, Heinke J, Hoff H, Biemans H, Fader M, Waha K. Global Water Availability and Requirements for Future Food Production. J Hydrometeorol. 2011;12: 885–899. doi:10.1175/2011JHM1328.1

24. Seung-Hwan Y, Jin-Yong C, Sang-Hyun L, Yun-Gyeong O, Dong Koun Y. Climate change impacts on water storage requirements of an agricultural reservoir considering changes in land use and rice growing season in Korea. Agric Water Manag. 2013;117: 43–54. doi:10.1016/j.agwat.2012.10.023

25. McDonald RI, Girvetz EH. Two Challenges for U.S. Irrigation Due to Climate Change: Increasing Irrigated Area in Wet States and Increasing Irrigation Rates in Dry States. Ibekwe AM, editor. PLoS One. 2013;8: e65589. doi:10.1371/journal.pone.0065589

26. Brauman KA, Siebert S, Foley JA. Improvements in crop water productivity increase water sustainability and food security—a global analysis. Environ Res Lett. 2013;8: 24030. doi:10.1088/1748-9326/8/2/024030

27. Meixner T, Manning AH, Stonestrom DA, Allen DM, Ajami H, Blasch KW, et al. Implications of projected climate change for groundwater recharge in the western United States. Journal of Hydrology. 2016. pp. 124–138. doi:10.1016/j.jhydrol.2015.12.027

28. Vano JA, Voisin N, Cuo L, Hamlet AF, Elsner MM, Palmer RN, et al. Climate change impacts on water management in the Puget Sound region, Washington State, USA. Clim Change. 2010;102: 261–286. doi:10.1007/s10584-010-9846-1

29. Martínez-Austria P, Patiño-Gómez C. Efectos del cambio climático en la disponibilidad de agua en México. Tecnol y Ciencias del Agua. 2012;3: 5–20.

30. Herrera-Pantoja M, Hiscock KM. Projected impacts of climate change on water availability indicators in a semi-arid region of central Mexico. Environ Sci Policy. 2015;54: 81–89. doi:10.1016/j.envsci.2015.06.020

31. Aalst M Van, Adger N, Arent D, Barnett J, Betts R, Bilir E, et al. Climate Change 2014: Impacts, Adaptation, and Vulnerability. Assess Rep 5. 2014; 1–76. doi:10.1017/CBO9781107415379

32. Jeong SJ, Ho CH, Gim HJ, Brown ME. Phenology shifts at start vs. end of growing season in temperate vegetation over the Northern Hemisphere for the period 1982-2008. Glob Chang Biol. 2011;17: 2385–2399. doi:10.1111/j.1365-2486.2011.02397.x

33. Stöckle CO, Nelson RL, Higgins S, Brunner J, Grove G, Boydston R, et al. Assessment of climate change impact on Eastern Washington agriculture. Clim Change. 2010;102: 77–102. doi:10.1007/s10584-010-9851-4

34. Jones G V., Duff AA, Hall A, Myers JW. Spatial analysis of climate in winegrape growing regions in the western United States. Am J Enol Vitic. 2010;61: 313–326.

35. Paulson MD, Houston AI, McNamara JM, Payne RJH. Seasonal dispersal of pests: One

surge or two? J Evol Biol. 2009;22: 1193–1202. doi:10.1111/j.1420-9101.2009.01730.x

36. Zwiers FW, Zhang X, Feng Y. Anthropogenic influence on long return period daily temperature extremes at regional scales. J Clim. 2011;24: 881–892. doi:10.1175/2010JCLI3908.1

37. Deryng D, Conway D, Ramankutty N, Price J, Warren R. Global crop yield response to extreme heat stress under multiple climate change futures. Environ Res Lett. 2014;9. doi:10.1088/1748-9326/9/3/034011

38. Schlenker W, Roberts MJ. Nonlinear temperature effects indicate severe damages to U.S. crop yields under climate change. Proc Natl Acad Sci. 2009;106: 15594–15598. doi:10.1073/pnas.0906865106

39. Ramirez-Villegas J, Salazar M, Jarvis A, Navarro-Racines CE. A way forward on adaptation to climate change in Colombian agriculture: Perspectives towards 2050. Clim Change. 2012;115: 611–628. doi:10.1007/s10584-012-0500-y

40. IPCC. Managing the risks of extreme events and disasters to advance climate change adaptation. Special Report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press; 2012. doi:10.1596/978-0-8213-8845-7

41. Ohta S, Kimura A. Impacts of climate changes on the temperature of paddy waters and suitable land for rice cultivation in Japan. Agric For Meteorol. 2007;147: 186–198. doi:10.1016/j.agrformet.2007.07.009

42. Tao F, Zhang Z. Climate change, high-temperature stress, rice productivity, and water use in Eastern China: A new superensemble-based probabilistic projection. J Appl Meteorol Climatol. 2013;52: 531–551. doi:10.1175/JAMC-D-12-0100.1

43. Wassmann R, Jagadish SVK, Sumfleth K, Pathak H, Howell G, Ismail A, et al. Chapter 3

Regional Vulnerability of Climate Change Impacts on Asian Rice Production and Scope for Adaptation. Advances in Agronomy. 2009. pp. 91–133. doi:10.1016/S0065-2113(09)01003-7

44. Masutomi Y, Takahashi K, Harasawa H, Matsuoka Y. Impact assessment of climate change on rice production in Asia in comprehensive consideration of process/parameter uncertainty in general circulation models. Agric Ecosyst Environ. 2009;131: 281–291. doi:10.1016/j.agee.2009.02.004

45. Tao F, Zhang Z, Liu J, Yokozawa M. Modelling the impacts of weather and climate variability on crop productivity over a large area: A new super-ensemble-based probabilistic projection. Agric For Meteorol. 2009;149: 1266–1278. doi:10.1016/j.agrformet.2009.02.015

46. Thomson AM, Izaurralde RC, Rosenberg NJ, He X. Climate change impacts on agriculture and soil carbon sequestration potential in the Huang-Hai Plain of China. Agric Ecosyst Environ. 2006;114: 195–209. doi:10.1016/j.agee.2005.11.001

47. Carr MK V., Knox JW. The Water Relations and Irrigation Requirements of Sugar Cane (Saccharum officinarum): A Review. Exp Agric. 2011;47: 1–25. doi:10.1017/S0014479710000645

48. Luo Q, Bellotti W, Williams M, Wang E. Adaptation to climate change of wheat growing in South Australia: Analysis of management and breeding strategies. Agric Ecosyst Environ. 2009;129: 261–267. doi:10.1016/j.agee.2008.09.010

49. Wang B, Liu DL, Asseng S, Macadam I, Yu Q. Impact of climate change on wheat flowering time in eastern Australia. Agric For Meteorol. 2015;209–210: 11–21. doi:10.1016/j.agrformet.2015.04.028

50. Monterroso Rivas AI, Conde Álvarez C, Rosales Dorantes G, Gómez Díaz JD, Gay García C. Assessing current and potential rainfed maize suitability under climate change scenarios in México. Atmosfera. 2011;24: 53–67.

51. Gay C, Estrada F, Conde C, Eakin H, Villers L. Potential impacts of climate change on agriculture: A case of study of coffee production in Veracruz, Mexico. Climatic Change. 2006. pp. 259–288. doi:10.1007/s10584-006-9066-x

52. Schroth G, Laderach P, Dempewolf J, Philpott S, Haggar J, Eakin H, et al. Towards a climate change adaptation strategy for coffee communities and ecosystems in the Sierra Madre de Chiapas, Mexico. Mitig Adapt Strateg Glob Chang. 2009;14: 605–625. doi:10.1007/s11027-009-9186-5

53. Meza FJ, Silva D. Dynamic adaptation of maize and wheat production to climate change. Clim Change. 2009;94: 143–156. doi:10.1007/s10584-009-9544-z

54. Meza FJ, Silva D, Vigil H. Climate change impacts on irrigated maize in Mediterranean climates: Evaluation of double cropping as an emerging adaptation alternative. Agric Syst. 2008;98: 21–30. doi:10.1016/j.agsy.2008.03.005

55. Fischlin A, Midgley GF, Price JT, Leemans R, Gopal B, Turley C, et al. Ecosystems , their properties , goods and services. In: Parry ML, Canziani OF, Palutikof JP, van der Linden PJ, Hanson C., editors. Climate Change 2007: Impacts, Adaptation and Vulnerability Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press; 2007. pp. 211–272. doi:http://www.gtp89.dial.pipex.com/04.pdf

56. López-I-Gelats F, Contreras Paco JL, Huilcas Huayra R, Siguas Robles OD, Quispe Peña EC, Bartolomé Filella J. Adaptation strategies of Andean pastoralist households to both

climate and non-climate changes. Hum Ecol. 2015;43: 267–282. doi:10.1007/s10745-015-9731-7

57. CIP. Climate Change Take a Toll on Andean Potato Farming. International Potato Center. Apr 2012.

58. Parton WJ, Morgan JA, Wang G, Del Grosso S. Projected ecosystem impact of the Prairie Heating and CO2 Enrichment experiment. New Phytol. 2007;174: 823–834. doi:10.1111/j.1469-8137.2007.02052.x

59. Karl TR, Melillo JM, Peterson TC. Global Climate Change Impacts in the United States. Society. 2009.

60. Knapp AK, Harper CW, Danner BT, Lett MS. Rainfall Variability , Carbon Cycling , and Plant Species Diversity in a Mesic Grassland. Science (80-). 2002;298: 2202–2205. doi:10.1126/science.1076347

61. Heisler-White JL, Blair JM, Kelly EF, Harmoney K, Knapp AK. Contingent productivity responses to more extreme rainfall regimes across a grassland biome. Glob Chang Biol. 2009;15: 2894–2904. doi:10.1111/j.1365-2486.2009.01961.x

62. Howden SM, Crimp SJ, Stokes CJ. Climate change and Australian livestock systems: Impacts, research and policy issues. Australian Journal of Experimental Agriculture. 2008. pp. 780–788. doi:10.1071/EA08033

63. André G, Engel B, Berentsen PBM, Vellinga T V, Lansink a GJMO. Quantifying the effect of heat stress on daily milk yield and monitoring dynamic changes using an adaptive dynamic model. J Dairy Sci. 2011;94: 4502–13. doi:10.3168/jds.2010-4139

64. Wheelock JB, Rhoads RP, Vanbaale MJ, Sanders SR, Baumgard LH. Effects of heat stress on energetic metabolism in lactating Holstein cows. J Dairy Sci. 2010;93: 644–55.

doi:10.3168/jds.2009-2295

65. Hansen PJ. Effects of heat stress on mammalian reproduction. Philos Trans R Soc B Biol Sci. 2009;364: 3341–3350. doi:10.1098/rstb.2009.0131

66. Kadokawa H, Sakatani M, Hansen PJ. Perspectives on improvement of reproduction in cattle during heat stress in a future Japan. Animal Science Journal. 2012. pp. 439–445. doi:10.1111/j.1740-0929.2012.01011.x

67. Byford RL, Craig ME, Crosby BL. A review of ectoparasites and their effect on cattle production. Journal of animal science. 1992. pp. 597–602. doi:10.11648/j.avs.20140204.17

68. McKeon GM, Stone GS, Syktus JI, Carter JO, Flood NR, Ahrens DG, et al. Climate change impacts on northern Australian rangeland livestock carrying capacity: A review of issues. Rangel J. 2009;31: 1–29. doi:10.1071/RJ08068

69. Moore AD, Ghahramani A. Climate change and broadacre livestock production across southern Australia. 1. Impacts of climate change on pasture and livestock productivity, and on sustainable levels of profitability. Glob Chang Biol. 2013;19: 1440–1455. doi:10.1111/gcb.12150

70. Hanslow K, Gunasekera D, Cullen B, Newth D. Economic impacts of climate change on the Australian dairy sector. Aust J Agric Resour Econ. 2014;58: 60–77. doi:10.1111/1467-8489.12021

71. Nidumolu U, Crimp S, Gobbett D, Laing A, Howden M, Little S. Heat stress in dairy cattle in northern Victoria: Responses to a changing climate. 2010.

72. Reisinger A, Kitching R, Chiew F, Hughes L, Newton PCD, Schuster SS, et al. IPCC Chapter 25: Australasia. Clim Chang 2014 Impacts, Adapt Vulnerability Part B Reg Asp. 2014; 1371–1438. doi:10.1017/CBO9781107415386.005

73. Lieffering M, Newton PCD, Li FY, Vibart R. Hill country sheep and beef: impacts and adaptation to climate change. In: Clark A, Nottage R, editors. Enhanced climate change impact and adaptation evaluation: A comprehensive analysis of New Zealand's land-based primary sectors. Ministry for Primary Industries, New Zealand; 2012. pp. 145–188.

74. Hernández A, Domínguez B, Cervantes P, Muñoz-Melgarejo S, Salazar-Lizán S, Tejeda-Martínez A. Temperature-humidity index (TH1) 1917-2008 and future scenarios of livestock comfort in Veracruz, México. Atmosfera. 2011;24: 89–102.

75. Badjeck M-C, Allison EH, Halls AS, Dulvy NK. Impacts of climate variability and change on fishery-based livelihoods. Mar Policy. 2010;34: 375–383. doi:10.1016/j.marpol.2009.08.007

76. Heltberg R, Tarp F. Agricultural supply response and poverty in Mozambique. Food Policy. 2002;27: 103–124. doi:10.1016/S0306-9192(02)00006-4

77. Kassie M, Pender J, Yesuf M, Kohlin G, Bluffstone R, Mulugeta E. Estimating returns to soil conservation adoption in the northern Ethiopian highlands. Agric Econ. 2008;38: 213–232. doi:10.1111/j.1574-0862.2007.00295.x

78. Antle JM, Crissman CC. Risk, Efficiency, and the Adoption of Modern Crop Varieties: Evidence from the Philippines. Econ Dev Cult Change. 1990;38: 517–537. doi:10.1086/451813

79. Daw T, Adger W., Brown K, Badjeck M. Climate change and capture fisheries: potential impacts, adaptation and mitigation. Climate change implications for fisheries and aquaculture. 2009. doi:FAO Fisheries and Aquaculture Technical paper No. 530

80. Monterroso A, Conde C, Gay C, Gómez D, López J. Two methods to assess vulnerability to climate change in the Mexican agricultural sector. Mitig Adapt Strateg Glob Chang.

2014;19: 445–461. doi:10.1007/s11027-012-9442-y

81. Dercon S. Growth and shocks: Evidence from rural Ethiopia. J Dev Econ. 2004;74: 309–329. doi:10.1016/j.jdeveco.2004.01.001

82. Dercon S. Economic reform, growth and the poor: Evidence from rural Ethiopia. J Dev Econ. 2006;81: 1–24. doi:10.1016/j.jdeveco.2005.05.008

83. Skoufias E, Quisumbing AR. Consumption insurance and vulnerability to poverty: A synthesis of the evidence from Bangladesh, Ethiopia, Mali, Mexico and Russia. Eur J Dev Res. 2005;17: 24–58. doi:10.1080/09578810500066498

84. Kazianga H, Udry C. Consumption smoothing? Livestock, insurance and drought in rural Burkina Faso. J Dev Econ. 2006;79: 413–446. doi:10.1016/j.jdeveco.2006.01.011

85. Brondizio ES, Moran EF. Human dimensions of climate change: the vulnerability of small farmers in the Amazon. Philos Trans R Soc Lond B Biol Sci. 2008;363: 1803–1809. doi:10.1098/rstb.2007.0025

86. Saldaña-Zorrilla SO, Sandberg K. Impact of climate-related disasters on human migration in Mexico: A spatial model. Clim Change. 2009;96: 97–118. doi:10.1007/s10584-009-9577-3

87. Sietz D, Lüdeke MKB, Walther C. Categorisation of typical vulnerability patterns in global drylands. Glob Environ Chang. 2011;21: 431–440. doi:10.1016/j.gloenvcha.2010.11.005

88. BNPB. Indonesia's Disaster Risk Management Baseline Status Report 2015: Towards identifying national and local priorities for the implementation of the Sendai Framework for Disaster Risk Reduction (2015-2030). Indones Natl Disaster Manag Auth. 2016; 92.

89. Hedger MMK, Connell R, Bramwell P. Bridging the gap: Empowering decision-making for adaptation through the UK Climate Impacts Programme. Clim Policy. 2006;6: 201–215.

doi:10.1080/14693062.2006.9685595

90. Barnett J, O'Neill S. Maladaptation. Glob Environ Chang. 2010;20: 211–213. doi:10.1016/j.gloenvcha.2009.11.004

91. Morton JF. The impact of climate change on smallholder and subsistence agriculture. Proc Natl Acad Sci. 2007;104: 19680–19685. doi:10.1073/pnas.0701855104

ANNEX I – Previous workshop survey

This section has the answers of the previous survey sent to all the APEC economies that confirmed assistance.

Economy: Mexico

Organization: INIFAP

Name: Victor M Rodriguez-Moreno

1. What are the most important effects of climate change on agriculture in your economy?

   Increase of crop's water demands, shortening of growing season

2. What are the most significant impacts of climate change on the agricultural systems (livestock's, horticulture, cereals, among others) of your economy?

   Weakening in crops genotypes, new and more virulent pest/diseases, affectation on growing season, increase of crops' water demand

3. What percentage of GDP corresponds to a small and medium- sized agriculture in your economy? How important is employment related to agriculture in your economy? Please define small – medium sized agriculture for your economy

   6.5 M ha are irrigated, 3.5 M ha are of commercial production to export markets, 3.0 Mha for local or regional, irrigation water is obtained from dam, pumping plants, and deep well; land productivity is around USD1,500/ha. Agriculture and primary sector represent 452,218M de pesos (3T-2017), around 23M USD

4. What are the current actions and policies that your economy has implemented to ensure sustainable water use? Please refer to its performance, major gaps or problems the implementation

To promote between producers the implementation of precision agriculture managing actions, integrated Pest Management ICT-based, automated irrigation systems based on automated weather stations, climate forecast (by season -three months period and updating every day, and short term- 120 h updating every 24h. Major gaps is that network stations is decaying in time, instruments had lost precision and data sharing centers almost reach its storage capacity.

5. Which management mechanisms has your economy to prevent and react to emergencies due to extreme rain, floods or extreme droughts?

   Prevention. Monitoring is the key to prevent damages caused on economies due to natural disasters. A disaster is natural but when it combines with unprepared population, then it is a disaster.

Economy: Viet Nam

Organization: Directorate of Water Resources

Name: Nguyen Van Thanh

1. What are the most important effects of climate change on agriculture in your economy?

   Drought

2. What are the most significant impacts of climate change on the agricultural systems (livestock's, horticulture, cereals, among others) of your economy?

   Livestock's and horticulture

3. What percentage of GDP corresponds to a small and medium- sized agriculture in your economy? How important is employment related to agriculture in your economy? Please define small – medium sized agriculture for your economy

   In Viet Nam, Agriculture accounted 16.32 percent of GDP.

4. What are the current actions and policies that your economy has implemented to ensure sustainable water use? Please refer to its performance, major gaps or problems the implementation

   Irrigation and drainage law

5. Which management mechanisms has your economy to prevent and react to emergencies due to extreme rain, floods or extreme droughts?

   Prepare emergency disaster response plans, communication to raise awareness of people

Economy: Malaysia's agricultural research

Organization: Malaysian Agricultural Research & Development Institute (MARDI)

Name: Mohammad Hariz Bin Abdul Rahman

1. What are the most important effects of climate change on agriculture in your economy?

   Both flood and drought

2. What are the most significant impacts of climate change on the agricultural systems (livestock's, horticulture, cereals, among others) of your economy?

   Changing in climate affects yield. Prolong drought may reduce water supply especially for areas which depends on rain fed. Meanwhile, floods may become detrimental to on-going planting activities.

3. What percentage of GDP corresponds to a small and medium- sized agriculture in your economy? How important is employment related to agriculture in your economy? Please define small – medium sized agriculture for your economy

   2.4% of Malaysian GDP (overall) largely contributed from rubber and oil palm industry. However, SMEs GDP share of agriculture in the economy is 11.2%. SME for agriculture (also similar to other sectors) is defined as firms (or agricultural activity) with income earnings turnover not exceeding RM20[10] million or number of full-time employees not exceeding 75

4. What are the current actions and policies that your economy has implemented to ensure sustainable water use? Please refer to its performance, major gaps or problems the implementation

[10] RM means Malaysian ringgit, the official Malaysian coin

Water supply from irrigation is currently adequate to cater the demands from agricultural sector. However, there were cases especially during El- Nino in which small holder farmers struggled to fulfill water needs for their activities due to lack of access and infrastructure. Therefore, they have resorted to using of tube wells etc. However, the government continuously invest to improve infrastructure and conduct research to optimize water use in this sector. Credit or grants sometimes given as one off.

5. Which management mechanisms has your economy to prevent and react to emergencies due to extreme rain, floods or extreme droughts?

The annual budget on flood prevention program has been increased every year. Although this is focusing more on municipal aspects, spillover from infrastructure development may give positive impact on agricultural sector especially area within vicinity of cities or urban areas. Meanwhile, research especially on development of drought tolerant varieties is among the priorities, which is currently on going.

Economy: Chile[11]

Organization: National Irrigation Comision

Name: Mónica Rodriguez

1. What are the most important effects of climate change on agriculture in your economy?

2. What are the most significant impacts of climate change on the agricultural systems (livestock's, horticulture, cereals, among others) of your economy?

   The Climate change has arrive to Chile, producing many consequences for the agriculture. One of the most dangerous effects are were reducing de surface for agriculture, creating an uncertainty scenario for the Chilean farmers and for special to the smallholders. That is because, to the north-center territory there is longer dry seasons and more intense rain in short time. That is the same situation for the south-center in addition of an increase of the local temperature on summer season. They are many impacts, like the decreasing level of water sources for irrigation in all scales (like wells, dams, glaciers) reducing the plant cover and the available food for animals, a creating a risk

3. What percentage of GDP corresponds to a small and medium- sized agriculture in your economy? How important is employment related to agriculture in your economy? Please define small – medium sized agriculture for your economy

   Currently, Chile is working on the National Adaptation Plan against climate change, with other ones like the adaptation plan of the agroforestry sector, and the small and large accumulation reservoirs plan to improve water availability. In addition to these plans, is

[11] In the case of Chile,

working to foment the efficient use of water resource with the incorporation of new irrigation technology with many programs to support smallholders in order to help them against climate change.

4. What are the current actions and policies that your economy has implemented to ensure sustainable water use? Please refer to its performance, major gaps or problems the implementation

   Chile has three kinds of tools to work against many situations, called agriculture emergency decree, water emergency decree and catastrophic zone decree. These tools can release public resources from many ministries of Chile like agriculture, public works, etc. to work against the sinister. In case of a water emergencies decree, this can reassigned the water of the basin trying to optimize this resource. In case of an agriculture emergency decree, it can designate resource of many public institutes of Ministry of Agriculture, and for last, the catastrophic zone decree allows to use two percent (2%) of budget of Chile.

Economy: Russia

Organization: Ministry of agriculture, Russian APEC Study Center

Name: Tatiana Basarygina, Veronika Bondareva

1. What are the most important effects of climate change on agriculture in your economy?

   Increase of extreme events

2. What are the most significant impacts of climate change on the agricultural systems (livestock's, horticulture, cereals, among others) of your economy?

   There is a range of negative consequences for the agriculture sector that are caused by climate changes:

   -The disruption of stability that influence weather conditions in some regions;

   -Changes of time constraints of late spring and early autumn frost;

   -Changes of precipitation regime and increase the possibility of such events as drought and rain that may significantly influence soil or agricultural sector in whole;

   -Warming and temperature increase may have the impact on the rate development, number of microorganisms and insects, and intensity of breeding

3. What percentage of GDP corresponds to a small and medium- sized agriculture in your economy? How important is employment related to agriculture in your economy? Please define small – medium sized agriculture for your economy

4. What are the current actions and policies that your economy has implemented to ensure sustainable water use? Please refer to its performance, major gaps or problems the implementation

"There is a range of bodies that are responsible for sustainable development of water in Russia:

Ministry of healthcare:

-Responsible for drafting and implementing government policy and legal regulation in the area of healthcare, mandatory health insurance, the production and distribution of pharmaceuticals for medical use;

-the production and distribution of medical products, sanitary and epidemiologic welfare of the population, medical and sanitary support for people employed in industries with dangerous working conditions;

-the medical-biological assessment of the health hazards associated with hazardous physical or chemical factors, the resort and recreation industry, as well as the management of state property and provision of state services related to healthcare

Ministry of agriculture:

-drafting and implementing government policy and legal regulation in the agriculture and related industries, including livestock farming veterinary services, including pharmaceuticals, crop production, phytosanitary control, soil improvement and fertility, regulation of the farm produce, raw materials and foodstuffs markets, the food and food processing industry, the production and distribution of tobacco products, and the sustainable development of rural areas;

-drafting state policy and legal regulation in the fisheries industry, including fishing and fish farming (aquaculture), conservation of water biological resources, the manufacture, processing and sale of fish and other products from water biological resources, the business activities of fishing vessels; the protection, study, preservation and replacement of marine wildlife and protection of their natural habitats, excluding water biological resources in federal protected nature areas and listed in the Red Book of the Russian Federation;

-drafting and implementing state policy and legal regulation in the field of land relations (in the case of farmland), ensuring state monitoring of such land;

-providing state services related to agriculture, including the sustainable development of rural areas

The Ministry of Natural resources and Environment of Russia (The Federal Water resource Agency, Federal Service on Hydrometeorology and Environmental Monitoring):

-is a federal executive authority performing functions of public policy making and statutory regulation in the field of the renewal, and conservation of natural resources, including water bodies;

-coordinate and supervise the activities of the Federal Service for Hydrometeorology and Environmental Monitoring, the Federal Agency for Water Resources falling under its jurisdiction;

The Federal Water resource Agency:

-organizes the redistribution of water resources of federally-owned water bodies;

-organizes the development, conclusion, and realization of basin agreements on the restoration and conservation of water bodies;

-organizes, in accordance with the established procedure, preparation and implementation of flood-control measures, measures concerning designing and establishment of water protection zones of water bodies and their littoral protective zones, as well as measures to prevent and eliminate the harmful effects of water

Russian Association for Water and Wastewater:

-represents the consolidated position of the professional community of water industry in the public authorities,

-participates in the development of sectoral legislation,

-improve the legal framework,

-assists in the development and implementation of domestic innovative, energy-efficient technologies in the water sector,

-organizes scientific-practical forums, seminars and conferences,

-actively participates in international and domestic industry events"

5. Which management mechanisms has your economy to prevent and react to emergencies due to extreme rain, floods or extreme droughts?

Among the possible ways can be the development of climate-friendly agriculture and expansion of forestlands. Thus, Russia tries to create the favorable conditions for forest development – in 2013 state forest policy 2013-2020 aimed at modernizing forest management system and increasing forest quality and potential was launched. In December 2013, the federal law aimed at preventing illegal logging of timber and ensuring transparency of the market was also signed. According to law a unified state automated information system for registration of wood and deals with it was created. Users of the System are the federal and regional executive authorities and entrepreneurs. The system contains more than 3 mln documents on contracts, which are the basis for wood harvesting, the information about the declared and actual volumes of wood harvested, of all timber transactions, of each exported log of oak, beech is also provided there.

Economy: Indonesia

Organization: Ministry of Agriculture

Name: Ronny Mucharam

1. What are the most important effects of climate change on agriculture in your economy?

   Changes on the rainfall patterns

2. What are the most significant impacts of climate change on the agricultural systems (livestock's, horticulture, cereals, among others) of your economy?

   Cereals

3. What percentage of GDP corresponds to a small and medium- sized agriculture in your economy? How important is employment related to agriculture in your economy? Please define small – medium sized agriculture for your economy

4. What are the current actions and policies that your economy has implemented to ensure sustainable water use? Please refer to its performance, major gaps or problems the implementation

   Provide water storage such as dam, long storage and its irrigation system (channel), as well as water pump to ensure the field have adequate water to grows cereals crops (paddy), since 2016 until now, we have sufficient on paddy production.

5. Which management mechanisms has your economy to prevent and react to emergencies due to extreme rain, floods or extreme droughts?

   To prevent drought on paddy fields our economy has manage to build dam and other water storage including its channel system, these dam and water storage used to hold water during the high rainfalls and used while the dry season comes, distribute by channel or using water pump that has been provide to the farmers group.

Economy: Papua New Guinea

Organization: State Department of Agriculture & Livestock

Name: Heai Steven HOKO (Mr.)

1. What are the most important effects of climate change on agriculture in your economy?

   Changes on the rainfall patterns

2. What are the most significant impacts of climate change on the agricultural systems (livestock's, horticulture, cereals, among others) of your economy?

   Impact is on the food production systems causing low yield or biomass productivity and, hence, the food systems not achieving their economic production targets or levels per each season. The changes in the rainfall pattern can be described as 1) in-adequate rainfalls in certain areas causing isolated and distinct short-term to medium localized droughts; 2) the on-set of rainfalls are earlier than expected and/or late in coming, thus, disrupting planting and crop sowing, which eventually lead to crop failure, loss of seeds and loss of harvest; and 3) other areas, the intensity of rainfalls are higher than normal causing flooding and water-logging on croplands.

3. What percentage of GDP corresponds to a small and medium- sized agriculture in your economy? How important is employment related to agriculture in your economy? Please define small – medium sized agriculture for your economy

   Agriculture contributes 26% of the GDP, while the mineral and other extractive industry contribute 74% of the GDP. Most of the coffee, cocoa, rubber, coconut (& copra), oil-palm, betel-nut, fish, beech-de-mer, vanilla, spices and essences are produced by smallholder farmers/gardeners and rural family villagers, who make up about 80% of the economy population (2017 estimate: 8.5 Million people). Smallholder agriculture is very important as it enables 100% of rural peoples' employment and their need for cash income and domestic food production, shelter, medicine and other aesthetic and cultural and environment purposes. Small-holder farmers in PNG can be described as having cultivate food gardens on land areas ranging from 1,200 to 3,600 meters square, using family labor, simple tools, using heirloom seeds and planting materials and without using any fertilizers, pesticides, or imported seeds; and depend on manual labor for tilling the soils and all other garden chores. All food gardening and farming is carried using upland rain-fed system and shifting garden sites and slush-and-burning to check and maintain pest control and soil fertility loses. The medium-size agriculture or smallholder system consist all of the above but would include smallholder blocks of land ranging from 1 hectare to 15 hectares of land under cocoa, coconut, rubber, oil-palm and coffee for export earning, usually in neighboring and situated in regional areas where there are other smallholder schemes and large estate (20 hectares to 2000 hectares in size) production system in operation.

4. What are the current actions and policies that your economy has implemented to ensure sustainable water use? Please refer to its performance, major gaps or problems the implementation

PNG economic and agricultural policies and action plans are directed at the broader-level of issues on agriculture including 1) increasing and improving the productivity and farm outputs growth of main food staples, horticulture, small livestock, fish-farming; and increasing the efficiencies of the entire food value-chain; 2) build stability and resilience into food production and supply systems; 3) Enhancing nutrient content of food products consumed by nutritionally vulnerable households and individuals; 4) empowering women in agriculture as most food and home gardening in all rural and peri-urban areas are done or worked by women; and 5) strengthening governance, coordination, monitoring and communicating those policies and actions plans with all stakeholders. Currently, there are no specific policies and action plans been developed or are being developed in area of water-use and management for agricultural, horticultural, livestock including inland fishing and aquaculture purposes. Increasingly, the relevance of climate change and its impending impact on agriculture and other sectors are being discussed trough the economy as awareness are being raised through international fora and bilateral partnerships, however, the actual strategies and policies for intervention using sustainable water use or its control/management in flooded or seasonally inundated areas are not established yet for implementation. Capacity issues for human resource and funding sources for major sustainable water use and management projects is lacking in the economy.

5. Which management mechanisms has your economy to prevent and react to emergencies due to extreme rain, floods or extreme droughts?

The only management mechanism been utilized over the recent years, after the events of localized droughts and/or heavy rainfalls and massive flooding in the farming regions, communities and areas, have been to supply the affected rural-based communities with emergency food aid, drinking water, medicine, temporary shelter, and to some extent, new garden planting materials and seeds for the farmers to re-establish their food gardens and home.

Economy: Perú

Organization: Programa de Desarrollo Productivo Agrario Rural - AGRO RURAL

Name: Juan Mauro León Tuya

1. What are the most important effects of climate change on agriculture in your economy?

   Droughts, Frosts, Increase of extreme events, Changes on the rainfall patterns, Frosts

2. What are the most significant impacts of climate change on the agricultural systems (livestock's, horticulture, cereals, among others) of your economy?

   a) It changes the agricultural calendars, which means affect the planning of the production. In addition, it causes direct losses, because of mortality and morbility, diminishing performance of the systems. b) It guides the policy towards action of prevention such as technical assistance to mitigate the impact. Regarding this, Peru has a Disaster Risk Law. c) It produces economic losses and also increases the risks in food security. d) It enhances desertification process, soil erosion and water scarcity. Climate change increases the frequency and intensity of frosts. e) Rural population feels unprotected due to the loss of their investment capital

3. What percentage of GDP corresponds to a small and medium- sized agriculture in your economy? How important is employment related to agriculture in your economy? Please define small – medium sized agriculture for your economy

   According to the results of the National Agricultural Survey (ENA), in 2016 there were 2,260,973 agricultural units in Peru. Of this, 2,244,679 (99.3%) corresponded to small and medium-sized agricultural units and 16,294 (0.7%) to large agricultural units. The agricultural sector contributes 6% to the economy GDP, within this the small and medium agriculture contributes with 20%, on the other hand the sector absorbs 25% of the workforce in the Economy. However, according to economists the multiplier effect of agricultural economy it's 4 times its contribution to the economy GDP, because it is a vector to move other economies.

Small and medium-sized farmer are natural persons whose main economic activity is agriculture, livestock, and / or agroforestry, including the activities of primary processing and transformation of the products that they generate. It is characterized by the predominant use of the familiar labor force, limited access to resources such as land, water and working capital to support the family needs: and it is oriented to self-consumption, or unpaid agricultural work; which leads them to search for jobs outside or within agriculture. With respect to the management of the agricultural unit (UA), the small farmers manage agricultural land smaller than 5 hectares, and the medium-sized farmers manage lands smaller than 50 hectares.

4. What are the current actions and policies that your economy has implemented to ensure sustainable water use? Please refer to its performance, major gaps or problems the implementation

- National Policy on Water Resources: also known as Policy 33. And the role of the National Water Authority (ANA), in which priority is given to integrated water management, water use culture, investments, funding and hydraulic infrastructure, among others.

Law of Water Resources (Law No. 29338), with the objective of regulating the use and integrated water management, the actions of the State and stakeholders, as well as in the assets associated with it.

- PLANGRACC 2012-2021, in strategic axis 6, in strategic action 1.3, 1.4, recommends carrying out the integrated management of water resources.
- Creation of the ""Sierra Azul Fund"", to develop complementary activities in the field of ""sowing (collecting) and harvesting water"", all over the economy.
- Guidelines for the Agrarian Policy, on the Sustainable Management of Water and Soils, whose objective is to improve the management of water for agricultural use, which is carried out through the identification of lagoons of glacial origin in the sierra (highlands) and its and damming. Establishment of an integrated information system of surface and underground water sources involving irrigation users.
- Irrigation infrastructure and technology, whose guidelines are to increase the provision of agricultural infrastructure and irrigation of small and medium-sized agriculture families in the mountains and rainforest, as well as the technification of smallholding irrigation and private investment in irrigation infrastructure over the economy.

The problem lies in the limited implementation and insufficient budgets to achieve the programmed goals by the entities involved in the implementation of the instruments.

5. Which management mechanisms has your economy to prevent and react to emergencies due to extreme rain, floods or extreme droughts?

"The Agrarian Policy Guidelines mentions prevention and risk management with the objective to improve and expand the prevention and assistance to agricultural farmers and communities at the highest risk of events such as droughts, floods or frosts in the context of climate change. The implementation is carried out through the protection of water infrastructure and river channeling programs; and generating or promoting stakeholders with capabilities in disaster risk management, making use of permanent and scheduled activities.

To prevent or mitigate the adverse effect of adverse climatic phenomena such as excessive rainfall, drought, frost, etc. we make use of the Budget Program 0068 (Programa Presupuestal 0068) ""Reduction of vulnerability and emergency assistance due to disasters"".

- Preventive mechanisms

Excess of rains: regarding irrigation infrastructure, actions are carried out through the cleaning of river channels and river defense through the implementation of dams, reforestation or other activities.

In the agricultural activity, we carry out campaigns of deworming and treatment of the livestock population against diseases.

Droughts: Irrigation infrastructure; construction of irrigation canals and construction of small reservoirs. In the livestock activity, hay bales are delivered for supplementary feeding and the installation of cultivated pastures for haymaking.

In the agricultural activity, installation of crops with little water flow requirement and the use of seeds such as dormant alfalfa, fodder oats among others.

- Reactive mechanisms:

Droughts / Frost:

For livestock, we deliver bale hays and suplementary feeding and for agricultural activity we deliver installation crops, seed of cultivated pastures and foliar fertilizer. Also, we promote watershed management, infiltration ditches and reforestation.

Economy: Viet Nam

Organization: Global Integration and Investment Division

Name: DINH THI THANH HUYEN

1. What are the most important effects of climate change on agriculture in your economy?

   Sea Level rise

2. What are the most significant impacts of climate change on the agricultural systems (livestock's, horticulture, cereals, among others) of your economy?

   Horticulture and livestock are the most significant impacts of climate change in Viet Nam

3. What percentage of GDP corresponds to a small and medium- sized agriculture in your economy? How important is employment related to agriculture in your economy? Please define small – medium sized agriculture for your economy

   In Viet Nam, the people living by agriculture account for 70% of the population. At least 57% of the workforce works in the agricultural sector, but this sector generates less than 20% of the country's GDP.

   Small and medium-sized enterprises comprise 98% of Viet Nam´s total enterprises (including agriculture), contribute 40% of the GDP and 30% of the state budget, and generate half of all jobs. But SMEs have difficulties modernizing their equipment and facilities, finding new markets, and distributing their products.

4. What are the current actions and policies that your economy has implemented to ensure sustainable water use? Please refer to its performance, major gaps or problems the implementation

Identified as an economy significantly affected by climate change and rising sea levels, Viet Nam is also located downstream of two important international rivers, in which two-thirds of the water in Viet Nam flows from neighboring.

The development and implementation of integrated management strategies and strengthening of regional and international co-operation in managing water resources management are urgent needs.

5. Which management mechanisms has your economy to prevent and react to emergencies due to extreme rain, floods or extreme droughts?

   Nil

Economy: Thailand

Organization: Ministry of Agriculture and Cooperatives

Name: Nuntapon Nongharnpitak

1. What are the most important effects of climate change on agriculture in your economy?

   Changes on the rainfall patterns

2. What are the most significant impacts of climate change on the agricultural systems (livestock's, horticulture, cereals, among others) of your economy?

   The effect of climate change, including, floods, drought, and higher surface temperature, put Thailand's agriculture at risk. The damage to rice production has enormous economic impact and food security.

   Thailand have fluctuated such as seasonal shifts in rainy volume, decreasing number of rainy days, and more intense rain. Thailand, agriculture employs around 50% of population and contributes 10% of GDP.

   The implementing strategies to adapt to climate change on the agriculture are increasing number of farm ponds, develop irrigation system by increasing the efficiency of water distribution system, shift to grow less water consumption crops, and shift the cultivation period.

3. What percentage of GDP corresponds to a small and medium- sized agriculture in your economy? How important is employment related to agriculture in your economy? Please define small – medium sized agriculture for your economy

   "In 2017, GDP of Thailand is about US$ 404 billion; Thailand's agricultural sector produces US$ 36 billion or 9% of GDP. It is estimated that smallholder farmers produce around 80% of agricultural production (2016).

The size of farmlands in Thailand; small < 1.6 ha, medium 1.6-3.2 ha, and large > 3.2 ha."

4. What are the current actions and policies that your economy has implemented to ensure sustainable water use? Please refer to its performance, major gaps or problems the implementation

"Since 2011, the Thai government has set up the Strategic Committee for Water Resource Management (SCWRM) to formulate the master plan on sustainable water resource management to ensure the continuity of country's development. The objectives are:

1. Prevent and minimize losses and damages from medium to large scale flood.
2. Improve the capacity of flood prevention system.
3. Build confidence and stability and increase farmer, community, and member economy government income while managing water, land and forest for sustainable utilization.

Moreover, according to government policy, Royal Irrigation Department activities, Thailand irrigated area was increased, it ensured that the economy will have more water and food security."

5. Which management mechanisms has your economy to prevent and react to emergencies due to extreme rain, floods or extreme droughts?

"Thailand has the government organization to take care of the emergencies in case of extreme rain, floods or droughts. They are the Royal Irrigation Department and Department of Disaster Prevention and Mitigation.

“The Ministry of Agriculture and Cooperatives has opened its Smart Water Operation Center to link data with all relevant agencies for water resource management in a systematic manner during drought and flood crises. (The center is located inside the Royal Irrigation Department Headquarters).

It will also serve as a public relations center to handle information management from all agencies involved. When the economy faces severe droughts and floods, responsible officials will be able to work out plans and ease the disaster situation promptly and effectively.

Moreover, with the Smart Water Operation Center, relevant agencies will also be able to provide assistance to farmers in both the short term and the long term in order to reduce damage from water-related disasters. As for farmers, they will be able to plan their agricultural production in accordance with the water situation.

This center will bring information from relevant agencies to be compiled as central information for water analysis and forecasts. These agencies are, for example, the Meteorological Department, the Hydro and Agro Informatics Institute, the Geo-Informatics and Space Technology Development Agency, the Department of Water Resources, and the Hydrographic Department of the Royal Thai Navy.” http://thailand.prd.go.th/ewt_news.php?nid=5402&filename=index

“Department of Disaster Prevention and Mitigation has aimed at laying a solid foundation for the country’s disaster management practices, developing and strengthening institutional mechanisms and capacities, as well as identifying the overall strategic direction to guide the country’s disaster management.” http://www.disaster.go.th/th/index.php"

Economy: Perú

Organization: Gobierno Regional Piura

Name: Zoraida Aranibar

1. What are the most important effects of climate change on agriculture in your economy?

   Floods

2. What are the most significant impacts of climate change on the agricultural systems (livestock's, horticulture, cereals, among others) of your economy?

   The fruit trees are the most affected by climate change because the flowering stage is the most vulnerable in the vegetative cycle and when the minimum temperature increases, yields are reduced by up to 40%, resulting in a reduction in income and a migration of crops. peasants to the city in search of temporary jobs, government policy is supporting through the National Institute of Agricultural Research to provide technical support for crop management through floral induction and advance flowering with the help of alert systems early to predict temperatures four months in advance and apply crop management techniques when necessary

3. What percentage of GDP corresponds to a small and medium- sized agriculture in your economy? How important is employment related to agriculture in your economy? Please define small – medium sized agriculture for your economy

   Agriculture contributes 6% to GDP and represents 25% of the Economically Active Population (PEA) employed according to the 2007 Population Census, and in the case of small and medium-sized agriculture, it represents 70% of agricultural activity and represents 65% of the Rural Economically Active Population, in the last decade there have been changes in agricultural activity due to the commercial opening to international markets is therefore an activity that is growing as there are foreign investments that has generated acquisition of agricultural land to small farmers for have large extensions and generate an important agro-export activity. The export crops have the greatest dynamism in terms of the cultivated area are: coffee, cocoa, asparagus, mango, beans, bananas, grapes and artichokes are the crops that show the greater expansion on the surface, on the other hand the Government has been working to train and strengthen small farmers those who have between 01 - 05 has. in the management of crops in the valleys that have regulated irrigation, launching technified irrigation programs and promoting associativity so that they can obtain better income and eliminate from the marketing chain the intermediaries who paid them a non-competitive price, in the case of mango the perception of the small farmer indicates that the price they paid in this campaign for their product was 10 times more expensive than when they were not associated

4. What are the current actions and policies that your economy has implemented to ensure sustainable water use? Please refer to its performance, major gaps or problems the implementation

There are integral watershed management plans to optimize the use of water in a sustainable manner, the Government is allocating budgetary allocations to projects to implement climate change adaptation measures such as reforestation in the headwaters of the basin to regulate water resources and reduce erosion of soils and landslides which cause great mudslides and overflows of rivers, implement reservoirs in the middle basin to avoid the overflows of rivers in the lower valleys and therefore floods, likewise this use serves to regulate the water supply in eras of drought prioritizing the irrigation of permanent crops, however the difficulty is that they are medium and long-term measures and extreme events occur even before their implementation, there is still much to resolve.

5. Which management mechanisms has your economy to prevent and react to emergencies due to extreme rain, floods or extreme droughts?

In the case of the northern area affected by El Niño phenomenon, the Peru Government allocates resources for prevention in activities such as river cleaning in 2015 with USD $ 75 million because El Niño phenomenon was predicted, as well as the warning system early however, things have not been done well, this activity has not been enough because since the last phenomenon occurred in 98 'an extensive vegetation has grown as trees of great dimension that make the natural course of the river impossible, which leaves a smaller hydraulic box, and the cleaning river activity only considered movement of land from the center of the river to the slopes and that impaired whose result was evidenced by the overflow of the river with 3,600 m3/s leaving the middle and lower valleys flooded and the systems of warning did not work, unfortunately it was a failure

Economy: México

Organization: Instituto Mexicano de Tecnología del Agua

Name: Sandra Vázquez Villanueva

1. What are the most important effects of climate change on agriculture in your economy?

   Changing weather patterns

2. What are the most significant impacts of climate change on the agricultural systems (livestock's, horticulture, cereals, among others) of your economy?

   Decrease in yields, decrease in quantity and quality of water, erosion, decrease in income, the value of production, will also affect the value of the land, damaging the heritage of the inhabitants in rural areas.

3. What percentage of GDP corresponds to a small and medium- sized agriculture in your economy? How important is employment related to agriculture in your economy? Please define small – medium sized agriculture for your economy

   La información del PIB es agregada, con un valor del 4%. La agricultura proporciona empleo a alrededor de 13% de la fuerza de trabajo, lo que representa unos 3.3 millones de agricultores y 4.6 millones de trabajadores asalariados y familiares no remunerados. De mayor relevancia aún para el desarrollo territorial es el hecho de que aproximadamente 24% de la población total vive en las zonas rurales (usando cifras de 2005) (OCDE, 2011). La pequeña agricultura o agricultura familiar considera a los productores agrícolas, de recursos limitados que, pese a su gran heterogeneidad, poseen las siguientes características principales: acceso limitado a recursos de tierra y capital, uso preponderante de fuerza de trabajo familiar, siendo el(la) jefe(a) de familia quien participa de manera directa del proceso productivo (Sagarpa, 2012).

The GDP information is aggregated, with a value of 4%. Agriculture provides employment for around 13% of the labor force, representing some 3.3 million farmers and 4.6 million wage and unpaid family workers. Of even greater relevance for

Territorial development is the fact that approximately 24% of the total population lives in rural areas (using 2005 figures) (OECD, 2011). The small agriculture or family agriculture considers the agricultural producers, with limited resources that, despite their great heterogeneity, have the following main characteristics: limited access to land and capital resources, preponderant use of family labor force, being the family head who participates directly in the production process (Sagarpa, 2012).

4. What are the current actions and policies that your economy has implemented to ensure sustainable water use? Please refer to its performance, major gaps or problems the implementation

Manejo integrado de cuencas, implementación de tecnologías apropiadas, infraestructura resiliente.

Integrated watershed management, implementation of appropriate technologies, resilient infrastructure

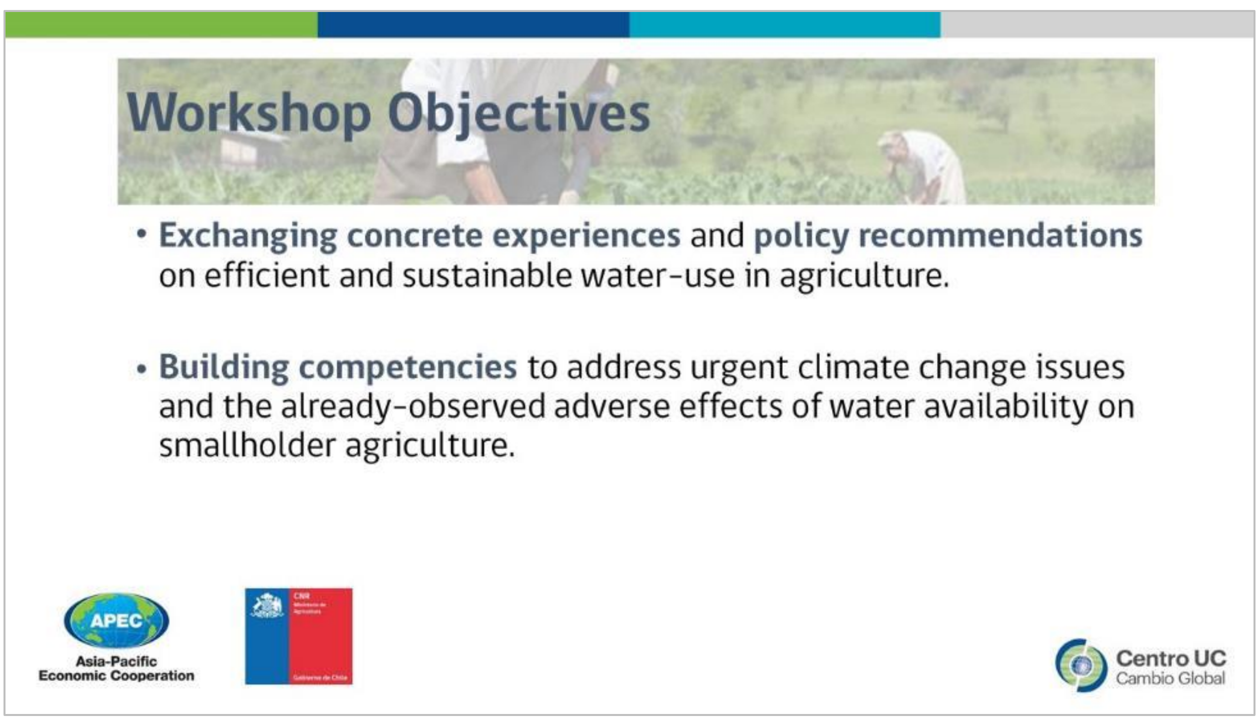
5. Which management mechanisms has your economy to prevent and react to emergencies due to extreme rain, floods or extreme droughts?

"Innovaciones en el sector, la generación de nuevas tecnologías de producción agropecuaria que contemplen el desarrollo de nuevos cultivos, variedades y razas que sean más resistentes a los cambios de temperatura, de humedad y de otras variaciones climáticas, y sean resistentes a la presencia de plagas y enfermedades. El fortalecimiento de las capacidades de adaptación a nivel institucional para la integración del cambio climático en todas las políticas y programas del sector agropecuario, apoyando a mecanismos de decisión intersectorial. Modificación de las prácticas agropecuarias.

Innovations in the sector, the generation of new agricultural production technologies that contemplate the development of new crops, varieties and breeds that are more resistant to changes in temperature, humidity and other climatic variations, and are resistant to the presence of pests and diseases The strengthening of institutional adaptation capacities for the integration of climate change in all policies and programs of the agricultural sector, supporting decision-making mechanisms intersectoral Modification of agricultural practices

ANNEX II – Workshop transcriptions

Workshop PowerPoint Presentation



Work Methodology

- **Module 1: “top-down” approaches**
  - Exchange experiences about **policies and strategies** to address climate change at the **national level**.

- **Module 2: “bottom-up” approaches**
  - Exchange experiences of **local adaptations** to assist with sustainable water use.

Asia-Pacific Economic Cooperation

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Group structure & responsibilities

- **Moderator:** guide group conversation
- **Secretary:** compile group responses.
- **Presenter:** provide main discussion points in the Review Session.

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Process of group discussion

- Discussion **between economy members** (~10 min)
  - Write economy responses **on the cards**.
  - **Post the cards** on the boards under the question numbers.
- Discussion **within the group** (~20 min)
  - Present **selected responses** from each economy
  - **Convey the message** from your economy to the secretary
  - Secretary is in charge of noting down **constructive discussion items**
- Don't worry about not remembering precise details.
  - Send specific details in the **follow-up questionnaire**.

Module 1: **"Top-down" approach**

Strategies and policies to address climate change impacts on small- and medium-sized agriculture

Q1. What are the **current actions and policies** that your economy has implemented for **water management** and **sustainable water use**? Please refer to its **performance**, **major gaps**, or **implementation challenges**.

Q2. What **communication and coordination mechanisms** are available in your economy to **prevent and react to emergencies** caused by **extreme rains**, **floods**, or **extreme droughts**?

"Smallholders' Response to New Climate Scenarios regarding Sustainable Water Use as a Contribution to Food Security"

Asia-Pacific Economic Cooperation

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Module 2: **"Bottom-up" approach**

Adaptive capacity to cope with sustainable water use impacts from climate change by small and medium agriculture.

Q3. What are the **main challenges** to ensure **food security** to adapt to the new climate change scenarios at the local level? Please focus on

I. Role of smallholders

II. Role of research organizations

III. Role of **local** government

Q4. What are the **main actions** and **best practices** to be taken to adapt to climate change and **ensure sustainable water use** by smallholders? What are some **successful local actions** (technical, institutional, economic, etc.)?

Asia-Pacific Economic Cooperation

Centro UC Cambio Global

"Smallholders' Response to New Climate Scenarios regarding Sustainable Water Use as a Contribution to Food Security"

Asia-Pacific Economic Cooperation

Centro UC Cambio Global

Review of Workshop Discussions

- Each **group presenter** will share their group's **main discussion points** from **both modules**.

Each presentation approximately **8 minutes**

Asia-Pacific Economic Cooperation

Centro UC Cambio Global

"Smallholders' Response to New Climate Scenarios regarding Sustainable Water Use as a Contribution to Food Security"

APEC
Asia-Pacific Economic Cooperation

Centro UC Cambio Global

Closing Session

Main ideas and **highlights**
discussed in the workshop

APEC
Asia-Pacific Economic Cooperation

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Follow-up Survey

- Post-workshop survey:
  Provide **additional details and specificity** to responses mentioned during workshop discussions.

due by **8 December 2017** at **5pm**
(Chile time)

Asia-Pacific
Economic Cooperation

Centro UC
Cambio Global

"Smallholders' Response to New Climate Scenarios regarding Sustainable Water Use as a Contribution to Food Security"

Asia-Pacific
Economic Cooperation

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Workshop working material

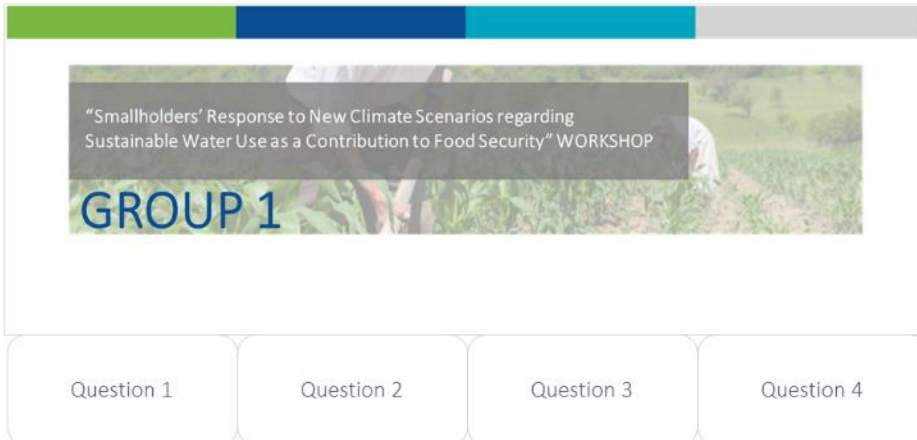

Figure 1 Example of Flipchart on boards.

Workshop transcriptions from the flipcharts

The work that was done during the workshop, was reflected in the flipcharts of each group. A work of transcription of the cards was made, reflected in the following answers.

GROUP 1: Thailand;Chile and Perú.

1.- What are the current actions and policies that your economy has implemented for water management and sustainable water use? Please refer to its performance, major gaps, or implementation challenges.

Thailand:

Water Management:

- Reduce high water consumption water plantation (paddy rice)
- Increase number of farm production

Increase water use efficiency

- Water distribution
- Protect seawater intervention

The new agriculture theory: 30% rice, 30% Fruits and trees upland crops, 30%pond and fishery, 10% house.

Perú:

Government created sierra Azul project, in order to secure water by capturing precipitation and store in the highland. That can be water resources for lower land

Chile:

Two important laws:

- Government gives rights of water to the private sectors. The farmers can buy water rights from private sector
- Government gives funding to the private sectors to manage and invest irrigation systems for higher irrigation efficiency. This can increase the competitiveness of agricultural exports

2. What communication and coordination mechanisms are available in your economy to prevent and react to emergencies caused by extreme rains, floods, or extreme droughts?

Thailand:

- Department of disaster prevention and mitigation
  - Capacity building and promote knowledge on water-related disasters
  - Response and mitigate disasters
- Government set up smart water operation center for nearly Realtime warning /Big data management

Perú:

- National Institute for civil protection (INDECI)
  - Study the past events and forecast for the future events
  - National plan of risk management and adaptation to climate change (Plan GRACC)

Chile:

- National office of emergency (ONEMI): Designated ministers to cope with each disaster

- Agroseguro: Agriculture insurance

3. **What are the main challenges to ensure food security to adapt to the new climate change scenarios at the local level? Please focus on**

   I. Role of smallholders

   II. Role of research organizations

   III. Role of local government

Thailand:

Smallholders

- Must change their behaviors from mono-crops to integrated farms

Research Org

- Purpose sustainable alternative ways: cropping patterns, cooperatives research

Government:

- Encourage small farmer into sustainable adaptation and incentive agri-map

Peru and Chile:

- Organization (Local and economy level)
- Contribution of research to the decision facts
- More participation of population
- More equitable distribution of water and other resources

4. What are the main actions and best practices to be taken to adapt to climate change and ensure sustainable water use by smallholders? What are some successful local actions (technical, institutional, economic, etc.)

Thailand:

Main actions and best practices:

- Zoning by agri-map- Develop agrimap database online-mobile
    - To optimize carp production by changing non- sustainable crop to more sustainable alternative.
        - Non-snit-rice: XXXX/Econ. Crop – Fishing
        - Integrated family
        - Livestock production
- Agri-map online and on mobile
    - Soil map
    - Irrigation map
    - Land use map
    - Market info and location
    - Land sustainability map
    - Economic info.
- Alternative wet and day paddy cultivation

Peru:

- Sierra Azul, invested by government
- Implementation of a new law (Familiar agriculture)
    - To give founding directly to farmers

        - Technical support from the gob
- Tupicocha, implemented areas from best practices
        - Micro-reservoirs

Chile:

Local actions and expertise:

- Irrigation law, special program to smallholders
- Use of ERNC to irrigation systems (solar cells)
- Harvest to rain water
- Program to recuperation of soils and water (soil and water conservation program, soil improvement)
- Main actions: Organization and participate of smallholders

- GROUP 2: Indonesia; Chile and Perú.

1.- What are the current actions and policies that your economy has implemented for water management and sustainable water use? Please refer to its performance, major gaps, or implementation challenges.

Indonesia:

Current actions

- Rehabilitation of existing irrigation Systems by improving the reservoir and main canal.
- Construction of new reservoirs and irrigation networks
- Improvement of water catchment area

- Development of small scale irrigation through the manufacture of small weir. Small reservoirs, pumping surface
- Optimization of swampland use during el niño.

Performance:

- Improvement of water canals (primary secondary, tertiary) +- 3 mil ha.
- Construction of 65 damns
- Construction of small-scale water reserve (30.000 Units – Until 2019)

Gaps

- 80% for Agricultural sectors with in efficient use.
- Water needs competitions (Agricultural, industrial, domestic use)
- New Technology for rice irrigations is still to expensive

Chile:

- Big and small dams for water accumulation for multi uses (policy)
- Farmers training on water irrigation regarding to crop adaptation to climate change (Working on it, Policy and GAP),
- Stakeholders coordination in rainfed areas for implementation of strategy 2030 (GAP)
- Rainfed – Dryland areas strategy implementations 2030 (GAP)
- Non- conventional sources of water for irrigation and technologies for treatments (GAP)

2. What communication and coordination mechanisms are available in your economy to prevent and react to emergencies caused by extreme rains, floods, or extreme droughts?

Indonesia:

- National disaster management authority (BNPB)
- The coordinator is under the ministry of economy involving relevant ministry's

Perú:

Chile:

3. What are the main challenges to ensure food security to adapt to the new climate change scenarios at the local level? Please focus on

I. Role of smallholders

II. Role of research organizations

III. Role of local government

Indonesia:

The role of the farmer

- Involve in planning to develop (small reservoir and small irrigation)
- Create new innovation.
  - New variety that can adapt to CC (under supervision of AARD)
    - The role of local government is to give assistance and financial aid to the program of adaptation of mitigation of climate change

4. What are the main actions and best practices to be taken to adapt to climate change and ensure sustainable water use by smallholders? What are some successful local actions (technical, institutional, economic, etc.)

Indonesia:

- Farmers have built small reservoir and actively involved in managing and operation as well as in maintaining the small irrigation.
- There is local wisdom that farmers use for climate prediction.
- Behavior change from wasteful of water to be water efficient use.

Peru:

- Agro-meteorological warning system for valleys under irrigation
- Technified irrigation systems by groups of small farmers
- Implementing adaptation measures to climate change such as:
  - Drip and sprinkler irrigation systems for small farmers
  - Management of dry forest to avoid migration by taking advantage of dry forest sub-products and taking advantage of production when there is rain.
  - Both programs allow to improve irrigation supply and efficiency.

Chile:

Best Practices:

- Schemes for payment on ecosystem services, particularly water services provided by forest for human welfare.
- Pilot projects: Peñablanca, Cerro Blanco. Best Practice: Rainwater harvest to address impacts of climate change in rainfall regime (Half million people affected during megadrought).

- GROUP 3: China; Mexico and Chile.

1.- What are the current actions and policies that your economy has implemented for water management and sustainable water use? Please refer to its performance, major gaps, or implementation challenges.

China:

Policies and law issued by agricultural service department in two levels, national and local level.

- -Action on promoting agri-water conservation (MOA)
- Action plan for coping with climate change in agriculture (MOA)

Current Actions

- Tax on water resources
- Reform on water rights
- Implement training plan on new technologies of saving water
- Develop association of water

Mexico:

- Mobile Apps
- Forecast weather
    - Short term
    - Seasonal term
- Web Services
    - - Irrigation recommendation indicators
    - - ET
    - - 23 crops water needs

GAPS:

- - Maintenance of AWS´s
- - Legal property of data set

+Increase number of AWS

+Link with institutions

Chile:

Using the water in an efficient way:

- Education of the users so they understand what they are doing when they irrigate (in his way to be implemented)
- Subsidy to the irrigation system improvement
- Subsidy to the water organization to improve the water conduction
- Extension programs

2. What communication and coordination mechanisms are available in your economy to prevent and react to emergencies caused by extreme rains, floods, or extreme droughts?

China:

Central Government:

- "National flood control and drought emergency plan"

Local government:

- Implementation and training

Meteorology agent:

- Weather forecast
- If emergency happened, the first step I to establish work group to coordinate

Mexico:

Mexico is coordinated at the federal level through the National Water Commission. It monitors and issues civil protection alerts in the states or municipalities. There are specialized programs to deal with emergencies. E.j. Economy program against drought, security of dams, AlerMapCore weather monitor App

Chile:

- For El Niño phenomenon; the regional and Economy Government implement prevention activities such as:
  - Clear rivers from word and plants
- Sistema Nacional de Gestion de Riesgos y Desastres: that purpose; Hazard map by regions in order to reduce the risk in the projects and estimate what it the interaction cost of the risk reduction measures.
- Early warning systems
- Protection dike

3. What are the main challenges to ensure food security to adapt to the new climate change scenarios at the local level? Please focus on

I. Role of smallholders

II. Role of research organizations

III. Role of local government

China:

- The Role of smallholders
  - Rising labor cost (small-scale)

- Relative less agriculture income
- Female labor engaged in agriculture activities
- Difficulty to learn new technology

- The role of research organizations
  - New variety Rand D
  - Technology innovations
  - Technology demonstrations
- Local Government
  - Pay less attention to agriculture
  - Lack of investment on agriculture and infrastructure
  - Constant finance

Mexico:

- Revenue genetics resources
- Strength production chain (more apps, international price market)
- Potentiate users with useful information
- Strength extension programs
- Coordinate research institutions, policy makers, producers and academics (Socialize data, socialize information)

Chile:

- Transfer to small landowners understanding on the potential impacts of climate change in the context of the massive extinction of the Anthropocene.
- Implementation of National Strategies such as the National Strategy on Climate change vegetation Resources"

- To develop research programs to assure conservation of natural resources in catchments such as epigenetics, niches (current futures). in a scenario of unpredictable climate change.
- Carry out in the field programs on adaptation to the impacts of climate change, land degradation, desertification and drought. In special, adaptation measures for conservation of vegetation in catchments.

4. What are the main actions and best practices to be taken to adapt to climate change and ensure sustainable water use by smallholders? What are some successful local actions (technical, institutional, economic, etc.)

China:

Technical:

- Water saving irrigation methods (drip, spryly micro irrigation) inter mitten, plastic filen, till age, water celler/reservoirs.

Local actions,

- Water rights, water price (pilot) water user's associations, Grain for green program in mountain area.

Mexico:

- To deliver climate and water data in open access for all.
- To strength extension programs.
- Recognition production areas to natural.
- To adapt and update public affair according to water use and conservation.
- Mulching soil cover.
- Rain harvest water.

- Ancestral watershed management.
- Sustainable energy production.
- Weather prognostic.
- -Meccanization of soil conservation and water use.
- Aquafer water recharge.

Chile:

- Better Forecast for season about water availability
- Practices on better use and be-used of water at farmer level
- Communication strategy adaptation farmers (medias) (what and how)
- Trading and marketing strategies for products

- GROUP 4: Malaysia; Russia and Chile.

1.- What are the current actions and policies that your economy has implemented for water management and sustainable water use? Please refer to its performance, major gaps, or implementation challenges.

Malaysia:

- Actions implemented: National Integrated Resources water management plan. * Comprising water and land use, flood and drought management, agriculture.

Russia:

- Ministry of Agriculture (development):
  - Department of reclamation and irrigation (Program of modernization of irrigation systems).
  - Division of monitoring *Ministry of civil defense, emergencies and elimination of consequences of natural disasters (mitigation)

2. What communication and coordination mechanisms are available in your economy to prevent and react to emergencies caused by extreme rains, floods, or extreme droughts?

Malaysia:

- NADMA (under prime minister's department), coordinating agency for emergency response.

3. What are the main challenges to ensure food security to adapt to the new climate change scenarios at the local level? Please focus on

I. Role of smallholders

II. Role of research organizations

III. Role of local government

Malaysia:

- Local government:
  - Municipal council organized specific program, reuse, recycle.
  - Awareness program to save water improve river quality.
- Research organization:
  - Conduct improved, promoting new technologies in adaptation and mitigation, e.g.: Precision agriculture, new varieties tolerant to CC.
- Smallholders:
  - Nationals farmers organization (NAFAS); facilitate farmers in adaptation to climate change through organized business activities, crop production, etc.

Russia:

- Regional and local level: Ministry of agriculture, ministry of civil defense, (they decide what is important issue in their region and how to support it). Professionals associations.

4. What are the main actions and best practices to be taken to adapt to climate change and ensure sustainable water use by smallholders? What are some successful local actions (technical, institutional, economic, etc.)

Malaysia:

- Farmers awareness movement: To create awareness among paddy farmers to maintain services their irrigation system on their own, not dependent on government.
- Tube-well program: Initiated by the government but later maintained by the farmers

- Mechanization program: Under the supervision district farmers association (ppk). Optimum use of machinery.

- GROUP 5: Canada; Viet Namand Chile.

1.- What are the current actions and policies that your economy has implemented for water management and sustainable water use? Please refer to its performance, major gaps, or implementation challenges.

Canada:

- Canadian agricultural partnership.
- Agricultural Policy framework
  - Federal and provincial agreement on agricultural policies and programs.

Viet Nam:

Policies:

- Law on hydraulic works provide the opportunity new concepts of modernization for sector
- Law on water resources:
  - Allocated in economically on water resources from increased urbanization, industrialization, especially climate change.
- Law on natural disaster prevention

Chile:

- There is a plan to adapt to climate change to the climate change, coordinated by MINAGRI, which integrates politicians and currently binding instruments that play a relevant role in adaptation related to HR.
- Challenges or Gaps: Territorial or basin management policy that accounts for climatic diversity and availability of RR.HH.
- Training of human capital at different levels from professionals to direct operators of irrigation systems and equipment.
- National Strategy on Climate Change and Vegetational Resources (ENCCRV)

- Water policies
- Strengthening main actor's capacities.

2. What communication and coordination mechanisms are available in your economy to prevent and react to emergencies caused by extreme rains, floods, or extreme droughts?

Canada:

- Drought watch – Crop condition assessment program CCAD – Ag Can + statics
- Canada – Prov-Fed cooperation on flood response

Viet Nam:

- Develop disaster warming system based on communities
  - React to emergencies: set-up the coordination mechanism between provincial team and red cross.
  - Actions plans: National disaster mitigation strategy:
  - Provincial disaster mitigation plans
  - National Committee –Provincial – local

Chile:

- Weather forecast
- ONEMI (office that report the emergency responsable)
- Drought management though to -OUA (water user organization)

3. What are the main challenges to ensure food security to adapt to the new climate change scenarios at the local level? Please focus on

I. Role of smallholders

II. Role of research organizations

III. Role of local government

Canada:

Challenge: Finding into to guide decisions landowner v local gout: Two-way exchange of science (understanding issues at local level and feeding into to local level.)

Viet Nam:

- Smallholders – Lowering rainfall
  - Drought
- Government:
  - Sea level rise
  - Lowering water level in mains streams
  - Drought, Salt intrusion

- **Chile:**

- Smallholders learn and modify its way of doing things when they see productive and economic improvement
- Make available easy to use and implement technology
- Long term investment, extensions and research programs
- Start with education programs in schools

4. What are the main actions and best practices to be taken to adapt to climate change and ensure sustainable water use by smallholders? What are some successful local actions (technical, institutional, economic, etc.)

Canada:

- Organization around watersheds to deal with local issues.

- Conservation authorities (Flood management)
- Irrigation district (Infrastructure and water management)
- Living labs (watershed/landscapes based, research and technology transfer.)

Viet Nam:

- Review of the planning on water resources, Agriculture to adapt with extreme climate change

- Improve small farm irrigation

- Strengthen cooperation to share experience in for nation in the prevention of drought

Chile:

- Technical assistant to choose resistant varieties with less water requirements (or better adaptation climate conditions)
- Modify crops and crop practices, adapted to the water availability. Going to the basic problem, (- water and production ET, what is being irrigated, why is being irrigated) Pushing associativity between smallholders

Main activities pictures


Module 1: "Top-down" approach

Follow up survey

MALAYSIA

1.- What are the current actions and policies that your economy has implemented for water management and sustainable water use? Please refer to its performance, major gaps, or implementation challenges.

1) Malaysia has devised the National Integrated Water Resources Management (IWRM) Plan that set to implement the strategies and road map of water related industries in Malaysia. It consists of several components, namely; a) Integrated Lake Basin Management b) Integrated Aquifer Systems Management c) Water Demand Management d) Climate Change and Water e) Water Supply and Wastewater Management f) Integrated River Basin Management g) Agriculture Water Services for Agribusiness

2) Current status that reflects the implementation of IWRM includes the National Water Resource Policy that was launched in 2012. Meanwhile, on policy level, National Water Resource Council was also established which aimed to strengthen the management of water resources in the economy. In overall, there were 9 IWRM Best Management Practices (BMP) Projects currently implemented.

3) In future, there is a need for more IWRM management instruments to be developed. Currently, few instruments/ tools that were in used include (a) River Basin Decision Support System (RB-DSS), (b) IWRM Modelling Approach, and (c) IWRM Tool-BOX

2. What communication and coordination mechanisms are available in your economy to prevent and react to emergencies caused by extreme rains, floods, or extreme droughts?

The government has set up the National Disaster Management Agency (NADMA) which has three core functions, namely; a) Planning and preparedness, b) Operation activities (during disaster) and c) Post disaster management. This agency has been strategically placed under the Prime Minister's Department which coordinates the work of various agencies during disaster.

3. What are the main challenges to ensure food security to adapt to the new climate change scenarios at the local level? Please focus on

I. Role of smallholders

II. Role of research organizations

III. Role of local government

1) Role of small holder's Small holders actively participate through their respective organization to utilize any new technologies related to improvement of the efficiencies in their agricultural practices. These include optimizing the incentives given, following the standard agricultural guidelines as well as working closely with agricultural extensionist.

2) Role of research organizations Conduct research related to development of drought/ flood tolerant varieties, precision farming and nutrient use efficiencies. Since rice is a staple crop for the economy, there are also researches to develop anaerobic variety as well as development of alternate wetting and drying (AWD) cultivation technique for future implementation.

3) Role of local government Local municipal councils participate mainly in the awareness program related to water that include campaign to preserve the cleanliness and quality of rivers that have been the main source for water treatment plant in many parts of Malaysia.

4. What are the main actions and best practices to be taken to adapt to climate change and ensure sustainable water use by smallholders? What are some successful local actions (technical, institutional, economic, etc.)

Smallholders in Malaysia have been actively involved in various levels of farmer organizations that have been established and supported by the Government. These organizations support its members by human capital development, providing inputs, mechanization services, logistic services and provides welfare assistance. It has several subsidiary companies which conduct business related to agriculture. Under the flagship of National Farmers' Organization (NAFAS), there is also institution owned by farmers which is Area Farmer Organization or Pertubuhan Peladang Kawasan (PPK). This institution/ organization exist at the district level which facilitate farmers activity on agricultural inputs and procurement process from supplier for distribution at farm level. Farmers can reduce the cost of operation through participating in the organization which functions to improved and optimized production efficiency. These supply chain system works effectively for farmers to prepare themselves in the event of extreme weather. These include access to technologies, equipment and expert advice

Viet Nam[12]

1.- What are the current actions and policies that your economy has implemented for water management and sustainable water use? Please refer to its performance, major gaps, or implementation challenges.

i) Hydraulic work law (No 08/2017/QH14, dated 17.06.2017);

ii) Natural disaster prevention law (No 33/2013/QH13, dated19.06.2013);

iii) Water Resources law (No 17/2012/QH13, dated 21th June 2012)

iv). Viet Nam hydraulic work development strategy has been approved by Prime Minister (Decision No 1590/QĐ-TTg on 07.10.2009), with target of hydraulic work development serving economic, social and environmental development until 2020, vision to 2050, develop without conflict with future, adapt to climate change-sea level rise.

v) Viet Nam's strategy on climate change has been approved by Prime Minister (Decision No 2139/QĐ-TTg on 5/12/2011) with target ensuring food security, energy security, water resources security, poverty reduction, gender equality, social security, public health to improve living standards, to protect natural resources in the context of climate change

vi) Advanced- water saving irrigation, on-farm irrigation development policies

and to respond clime change, we have implemented many programs as: river dyke construction program, Quang Ngai-Kien Giang sea dyke program; repair and upgrade ensure the safety of dam reservoir program; development of small hydraulic work for mountainous, island areas; invest hydraulic work infrastructure serving aquaculture in red river delta, central Viet Nam, Mekong river delta...

[12] For the follow up survey, Viet Nam answer question one.

1.- What are the current actions and policies that your economy has implemented for water management and sustainable water use? Please refer to its performance, major gaps, or implementation challenges.

2. What communication and coordination mechanisms are available in your economy to prevent and react to emergencies caused by extreme rains, floods, or extreme droughts?

3. What are the main challenges to ensure food security to adapt to the new climate change scenarios at the local level? Please focus on

I. Role of smallholders

II. Role of research organizations

III. Role of local government

4. What are the main actions and best practices to be taken to adapt to climate change and ensure sustainable water use by smallholders? What are some successful local actions (technical, institutional, economic, etc.)

CHINA

1.- What are the current actions and policies that your economy has implemented for water management and sustainable water use? Please refer to its performance, major gaps, or implementation challenges.

—Agriculture's response to climate change mainly focused on a series of policies and laws initiated by the agricultural service department, including the Ministry of Agriculture, the Ministry of Forestry, the Ministry of Water Resources, the Meteorological Administration and the Oceanic Administration, etc. For instance, the Ministry of Agriculture and others issued "Advice on Promoting Agricultural Water Conservation", "Action Plans for Coping with Climate Change in Agriculture".

—The Ministry of Forestry researched, formulated, organized and implemented "Forestry Development Plan of Thirteenth Five-year", "National Forestry Management Plan 2016-2050", "Action Points for Coping with Climate Change in Forestry in Thirteenth Five-year period", "Action Plans for Coping with Climate Change in Forestry 2016-2050".

—The Ministry of Water Resources introduced "Eleventh Five-year Plan of Water-conserving Society Construction" and so on. All of these were trying to slow down and adapt the bad influences of climate change.

2. What communication and coordination mechanisms are available in your economy to prevent and react to emergencies caused by extreme rains, floods, or extreme droughts?

–The National People's Congress issued "Emergency Response Law of the Peoples Republic Law" in 2007

–China's State Council issued "National Environmental Emergency Plan" in 2014

— "Natural Disaster Relief Regulations" ordered by China's State Council in 2010

The above laws and emergency plans are to make institutional arrangements in response to extreme events caused by climate change.

3. What are the main challenges to ensure food security to adapt to the new climate change scenarios at the local level? Please focus on

I. Role of smallholders

II. Role of research organizations

III. Role of local government

The role of smallholder: Diversification increase labor input into non-farm activities, adjusting cropping systems from water intensive to water saving irrigation, including small stone water melons, wolfberry production, to increase the livestock breeding, rainwater harvesting – water cellar, range of soil moisture conservation methods; afforestation and control overgrazing

The role of research organization: Strengthen the scientific analytical tools for more precise assessment of climate change factors and their impacts on water and agriculture. The knowledge gaps still persist especially relating to the prediction of climate change impact. For instance, there is little consensus among climate scientists on how climate change would have an impact on precipitation at local levels and on interactions of CO2 fertilization effects and climate change. Different models lead to different predicted impacts on agriculture. Costs and benefits of adaptation in agriculture depend quite significantly on precipitation models, which can lead to significant variations in the prediction of yields of the same crop. This kind of uncertainties makes it difficult for policy makers to design efficient adaptation policies.

The role of local government: Help increase net water supply by developing further water collection and storage infrastructure and promote the use of alternative water resources in planning, investment and construction programs. Government programs for enhancing water harvesting technologies should be expanded. The mechanisms for collecting and storing water should be developed not only for large but also for medium, small and on-farm infrastructure for rainfall water harvesting and water collection and storage in reservoirs, ponds, dams and controlled rivers. Similarly, programs which artificially recharge groundwater should be tested in as many adequate sites as possible and then developed and expanded. Moreover, programs for the safe use of brackish and treated waste water in agriculture or for the recharge of aquifers should also be executed on a much larger scale.

4. What are the main actions and best practices to be taken to adapt to climate change and ensure sustainable water use by smallholders? What are some successful local actions (technical, institutional, economic, etc.)

Smallholder action: An efficient approach to improving irrigation management and increasing water productivity is to allocate increased responsibilities for water management and operation to farmers and other water users and to increase farmer participation through Participatory Irrigation Management (PIM) in form of Water Users' Associations (WUAs). WUAs are focuses on increasing farmers' direct involvement in system management, either as a complement or substitute for the state role.

Successful local action: When water shortages become serious and chronic, then stronger and more permanent solutions to conflicts are necessary. To resolve problems with officials from competing ministries working to divert as much of the scarce resource for their constituents as possible, many provinces and municipalities are promoting reforms to merge the functions of different water management units into a single authority. Although such units have different names in different places, most commonly they are called the Water Affairs Bureau (WAB--shuiwuju). The WABs, at the extreme, merge the personnel, resources, and duties of the local Water Resource Bureau (WRB), the Urban Construction Commission (UCC), and the water protection division of the local Environmental Protection Bureau (EPB) into a single, unit (Ministry of Water Resources, 1999).

PERU[13]

1.- What are the current actions and policies that your economy has implemented for water management and sustainable water use? Please refer to its performance, major gaps, or implementation challenges.

Considerando el agua un recurso de vital importancia en el caso del Perú, se hizo indispensable la formulación de una serie de instrumentos como como política de estado y ejecutado por programas y proyectos en manejo y gestión del agua:

- Política Nacional sobre los Recursos Hídricos, también conocida como Política 33 y el rol de la Autoridad Nacional del Agua (ANA), en el cual se prioriza la gestión integrada del agua, Cultura del Agua, Inversiones, financiamiento e infraestructura hidráulica entre otros, www.ana.gob.pe/.

- Ley de Recursos Hídricos (Ley N.º 29338), con el objetivo de regular el uso y gestión integrada del agua, la actuación del Estado y los particulares en dicha gestión, así como en los bienes asociados a esta. www.ana.gob.pe/media/316755/leyrh.pdf

- PLANGRACC 2012-2011, en el eje estratégico 6, en la acción estratégica 1.3, 1.4, recomienda realizar la gestión integrada del recurso hídrico, en este mandato el ente ejecutor es el Programa de Desarrollo Productivo Agrario Rural - AGRO RURAL, además realiza trabajos de reforestación, conservación de suelos y obras de infraestructura de riego, http://www.agrorural.gob.pe/; minagri.gob.pe/portal/download/pdf/especiales/plangracc/plangracc.pdf

- Creación del Programa “Fondo Sierra Azul”, para que desarrolle actividades complementarias en materia de "siembra y cosecha de agua", a nivel nacional. www. sierraazul.gob.pe/

[13] Peru answer question numer 1 and question number four for the follow-up survey

- Lineamiento de la Política Agraria, sobre el Manejo sostenible de agua y suelos, cuyo objetivo es mejorar la gestión del agua para uso agrario, que se realiza a través de los programas de identificación y represamiento de lagunas de origen glaciar en la sierra, establecimiento de un sistema integrado de información de fuentes superficiales y subterráneas de agua participación de los usuarios de riego.www.minagri.gob.pe/portal/.../pdf/p-agraria/lineamientos-pagraria-viceministro.pdf

- Infraestructura y tecnificación del riego, cuyo lineamiento es incrementar la dotación de infraestructura agraria y de riego de la pequeña y mediana agricultura familiar en sierra y selva, así como la tecnificación del riego parcelario y la inversión privada en infraestructura mayor a riego a nivel nacional.

- Se crea el Programa Subsectorial de Irrigaciones, PSI, para el uso eficiente del riego a través de diferentes técnicas de riego presurizado, principalmente en la costa del país. www.psi.gob.pe

4. What are the main actions and best practices to be taken to adapt to climate change and ensure sustainable water use by smallholders? What are some successful local actions (technical, institutional, economic, etc.)

En el caso del Perú, se vienen realizando una serie de actividades relacionados a la adaptación al cambio climático: Región COSTA, Caso Piura (norte del País) - Implementación de sistemas de alertas meteorológicas por valles en uso de agua bajo riego para los cultivos. - Implementación de Sistemas de riego tecnificado en pequeños agricultores organizados en valles productores de frutales. - Manejo de bosque seco, para evitar la migración de la población rural a la ciudad, y aprovechen la instalación de cultivos en secano o con agua de lluvia. Región SIERRA. Caso de Agro Rural (Programa de Desarrollo Productivo Agrario Rural) - Manejo de Microcuencas; en la parte alta se viene realizando acciones de reforestación y reforestación de laderas con especies forestales nativas, además del manejo racional de los pastos nativos a través de división de potreros con mallas ganaderas, complementados con zanjas de infiltración y la silva pastura. En la parte media se viene realizando el manejo de los suelos a través de la implementación de prácticas conservacionistas mecánico - estructurales y agronómicas como: construcción de zanjas de infiltración para la forestación, rehabilitación de andenes prehispánicos y terrazas en general, implementación de la agroforestería. Construcción de pequeños reservorios con geomembrana, arcilla o concreto y rehabilitación /construcción de canales de riego en tierra o concreto armado. -En la actividad agrícola se viene realizando la promoción de cultivos con poco requerimiento de agua como la instalación de cereales y tubérculos nativos, el uso de alfalfas "dormantes" en las partes altas, -En la actividad la ganadera se viene difundiendo la crianza de especies que tengan capacidad de resistencia a los fenómenos climáticos adversos, como los auquénidos sudamericanos (alpacas, ovinos principalmente). además de la construcción de cobertizos para la protección de la población de ganado susceptible a las heladas meteorológicas. - Por otro lado, se viene realizando el fortalecimiento de capacidades de los líderes campesinos en la actividad agropecuaria en el manejo de cultivos y crianza de animales en la sierra principalmente y en la forestación. - El Perú, a través de AGRO RURAL, viene implementando la Agricultura Familiar.

En caso del Programa "Sierra Azul", se viene implementando acciones de "siembra y cosecha de agua" en la cabecera de la cuenca alto-andinas de la sierra del país a través de la construcción de las "Cochas" para la retención de agua que será utilizado en la agricultura y ganadería principalmente

INDONESIA

1.- What are the current actions and policies that your economy has implemented for water management and sustainable water use? Please refer to its performance, major gaps, or implementation challenges.

Policies and programs that run in Indonesia for sustainable water management include:

1. Rehabilitation of existing irrigation systems, among others, by improving the reservoir and main canal.

2. Construction of new reservoirs and existing irrigation networks

3. Improvement of water catchment area

4. Development of small-scale irrigation through the manufacture of small weir, small reservoir, pumping by utilizing existing surface water sources.

5. Optimization of swamplands during El Niño

Performance

1. Improvement of key irrigation networks covering an area of 761,542 ha in 2017

2. Construction of new reservoir of 65 units (2014-2019)

3. Rehabilitation of tertiary irrigation networks covering 3 million ha (2015-2019)

4. Construction of small-scale water reserves of 30,000 units (until 2019)

5. Utilization of small-scale surface water source 5000 units (until 2019)

6. Pilot development for swampland use

Some major gaps

1. Utilization of irrigations water is still wasteful

2. Water needs competition (agricultural, domestic and industrial)

2. What communication and coordination mechanisms are available in your economy to prevent and react to emergencies caused by extreme rains, floods, or extreme droughts?

For the handling of extreme climates that cause floods, landslide drought is coordinated between relevant ministries and agencies under the coordination of the minister of economy. Ministries involved include agriculture, forestry and the environment, public works, domestic affairs, village ministries, ministries of disaster response.

The point is to make efforts to prevent the occurrence of disasters caused by extreme climates as well as efforts to handle if a disaster occurs.

3. What are the main challenges to ensure food security to adapt to the new climate change scenarios at the local level? Please focus on

I. Role of smallholders

II. Role of research organizations

III. Role of local government

To ensure climate change adaptation program in the framework of food security

1. The role of farmers

The development of small irrigation facilities has involved farmers to participate in the implementation of development. Provide training to farmers.

2. The role of research institutions

Encourage research institutions to create new innovations. This role under the research institute of the ministry of agriculture, among others, has created dry and puddle-resistant seeds and salt. Water conservation building etc.

3. Local Government

Involve local governments in financing, and farmer assistance to adapt

4. What are the main actions and best practices to be taken to adapt to climate change and ensure sustainable water use by smallholders? What are some successful local actions (technical, institutional, economic, etc.)

1. The government provides incentives for farmers to develop small-scale irrigation facilities. The facilities are done by farmers themselves.

	
This picture is an example of small-scale irrigation buildings made by farmers with government incentives	

2. Rotation of irrigation water use. Especially during the dry season
3. “Tabela” system of planting to avoid drought
4. The use of drought resistant and puddle resistant seeds
5. Utilization of cropping calendar

MEXICO

1.- What are the current actions and policies that your economy has implemented for water management and sustainable water use? Please refer to its performance, major gaps, or implementation challenges.

Performance:

- Mobile apps. CIT´s, GIT´s; iOS and Android
- Forecast weather (hourly)
  - National scale (ocean, continental, islands)
  - 4 variables (hourly)
    - Radar reflectivity
    - Speed wind
    - Ind direction
    - Air temperature
  - 11 variables daily
    - RH
    - Rain, hail gruel, soil water content, temperature soil
- Seasonal forecast (3 month; update 1 month)
- Web services

GAPS

- maintenance of AWS´s

- computer infrastructure

- Legal ownership of dataset

CHALLENGES

- Increase number of the station to wide coverture

- Broadly wide research project

- Join proposal for international funds

- Convince producers to adopt technology

2. What communication and coordination mechanisms are available in your economy to prevent and react to emergencies caused by extreme rains, floods, or extreme droughts?

- Forecast weather 1 h update, economy scale
- Civil protection by law coordinate efforts of all institutions to attend emergency
- Online and mobile version of Alert systems (seismic, hurricane, drought, heat wave)

3. What are the main challenges to ensure food security to adapt to the new climate change scenarios at the local level? Please focus on

I. Role of smallholders

II. Role of research organizations

III. Role of local government

- Value genetic resources
- Strength chain production
  - Apps for suppliers and brokers about international market prices
  - Web services
- Producers must participate (small and medium and large)
- An extensionist program integrated by research institutions and government, and producer's associations local government and policy marker must be in permanent coordination.
-

4. What are the main actions and best practices to be taken to adapt to climate change and ensure sustainable water use by smallholders? What are some successful local actions (technical, institutional, economic, etc.)

- Mulching farms lands (sand stone, wood, gel, crop residues, etc.)

- Drop irrigation systems promotion

- Rain water harvest

- conservation agriculture

- land use conservation

- reforestation program

-CIT´s and websites

- Forecast weather

- mechanization (robotics) to improve machines performance

- recharge aquifers

ANNEX III - Summit Program and Presentations

SMALLHOLDERS' RESPONSE TO NEW CLIMATE CHANGE SCENARIOS

November 29th Day 1 – Activities Program

8:30-9:00 Registration

9:00-9:30 Opening Remarks

CLIMATE CHANGE CONTEXT

9:30-10:00 **Climate change in a Global context**
Sebastian Vicuña, Center of Global Change. PUC, Chile.

10:00-10:30 **Climate change context on Chile**
Fernando Santibáñez, AGRIMED, University of Chile.

10:30-10:45 Round of Questions

10:45-11:15 Coffee Break

PLAN TO ADAPT TO CLIMATE CHANGE IN CHILE

11:15-11:45 **National Climate Change action plan**
Fernando Farías, Climate Change Division, Ministry of Environment of Chile.

11:45-12:15 **Climate Change adaptation plan for silvoagropecuary sector**
Claudia Carbonell, Office for Studies and Agrarian Policies, Ministry of Agriculture of Chile.

12:15-12:30 Round of Questions

12:30-12:45 Closing remarks

13:00-14:30 Lunch

SUPPORT POLICIES IN CLIMATE CHANGE ADAPTATION

14:30-15:00 **Agricultural policy adapt to Climate Change in China: an agriculture development perspective**
Xia Ying, IAED - Chinese Academy of Agricultural Sciences (CAAS), China.

15:00-15:30 **Agricultural policy adapt to Climate Change in north of Peru**
Zoraida Aranibar, Formulation Department Piura Government, Peru.

15:30-15:45 Round of question

15:45-16:15 Coffee Break

CLIMATIC MANAGEMENT ON AGRICULTURE

16:15-16:45 **Risk management in the agriculture**
Antonio Yaksic, Information, Monitoring and Prevention for Risk Management Department, Ministry of Agriculture of Chile.

16:45-17:15 **A view from afar: Space technology aiding agriculture in a Changing Climate**
Heather Mc Nairn, Research and Scientis Ottawa Research and Development Centre, Agriculture and Agri-Food, Canada.

17:15-17:30 Round of Questions

APEC
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CNR
National Commission of Irrigation

Chile mejor

SMALLHOLDERS' RESPONSE TO NEW CLIMATE CHANGE SCENARIOS

November 30th Day 2 - Activities

Program

8:30-9:00 Registration

LATINAMERICAN VISION OF CLIMATE CHANGE

9:00-9:30 **IICA experience on the capacity development o f mitigation and adaptation against climate change**
Jaime Flores, Inter-American Institute for Cooperation on Agriculture (IICA), Chile.

9:30-10:00 **Climate Change and sustainability in Latin America and the Caribbean**
José Javier Gõmez, Unit of Climate Change
Sustainable Development and Human Settlements Division, CEPAL, UN.

10:00-10:15 Round of Questions

10:15-10:45 Coffee Break

BEST PRACTICES RELATED TO WATER FOR THE SMALLHOLDER

10:45-11:15 **Rainwater harvesting systems in México**
Sandra Vásquez, Appropiate Technology Mexican Institute of Technologies on Water (IMTA), Mexico.

11:15-11:45 **Sierra Azul Peruvian experience of public investment on seeding and water harvesting**
César Dávila, Fondo Sierra Azul Ministry of Agriculture and Irrigation of Peru.

11:45-12:15 Round of Questions

12:30-14:30 Lunch

BEST PRACTICES RELATED TO WATER FOR THE SMALLHOLDER (2nd part)

14:30-15:00 **Irrigation management strategy against the Climate Change**
Gabriel Selles, National Institute of Agriculture Research (INIA), Ministry of Agriculture of Chile.

15:00-15:30 **Farmer adapt to Climate Change in China: an agricultural technology perspective**
Liu Jing, IAED - Chinese Academy of Agricultural Sciences (CAAS), China.

15:30-15:45 Round of Questions

15:45-16:15 Coffee Break

CLIMATIC MANAGEMENT ON AGRICULTURE FROM GOVERNMENT PRESPECTIVE

16:15-16:45 **Promotion of investment in irrigation works**
María Loreto Mery National, Commission of Irrigation, Ministry of Agriculture of Chile.

16:45-17:00 Round of Questions

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SMALLHOLDERS' RESPONSE TO NEW CLIMATE CHANGE SCENARIOS

December 01st Day 3 - Activities Program

08:30-09:00	Registration
09:00-10:20	First Module Workshop "Top-Down" Approach
10:20-10:40	Coffee Break
10:40-12:10	Second Module Workshop "Bottom-Down"
12:10-13:00	Review of the outcome of workshops
13:00-14:00	Closing Session and Cocktail

Workshop Objective

- Exchanging concrete experiences and policy recommendations on efficient and sustainable use of water in agriculture.
- Building competences to address urgent climate change issues and the already observed adverse effects on water availability for smallholders' agriculture.

Work Methodology

- Each group will have to dialogue in torn to two main questions in the module. The first module will focus in a "Top - Down" approach, in order to change experience about policies and strategies to face climate change at national level.
- The second module will focus in a "Bottom up" approach, oriented to exchange experience of local adaptations to cope sustainable water use.
- In this modules, each group should rescue the main ideas and Highlights obtained in the group.
- It should be designated a person who take note and a moderator that can guide the conversation.
- In the review session, one represent will present the main elements discussed.

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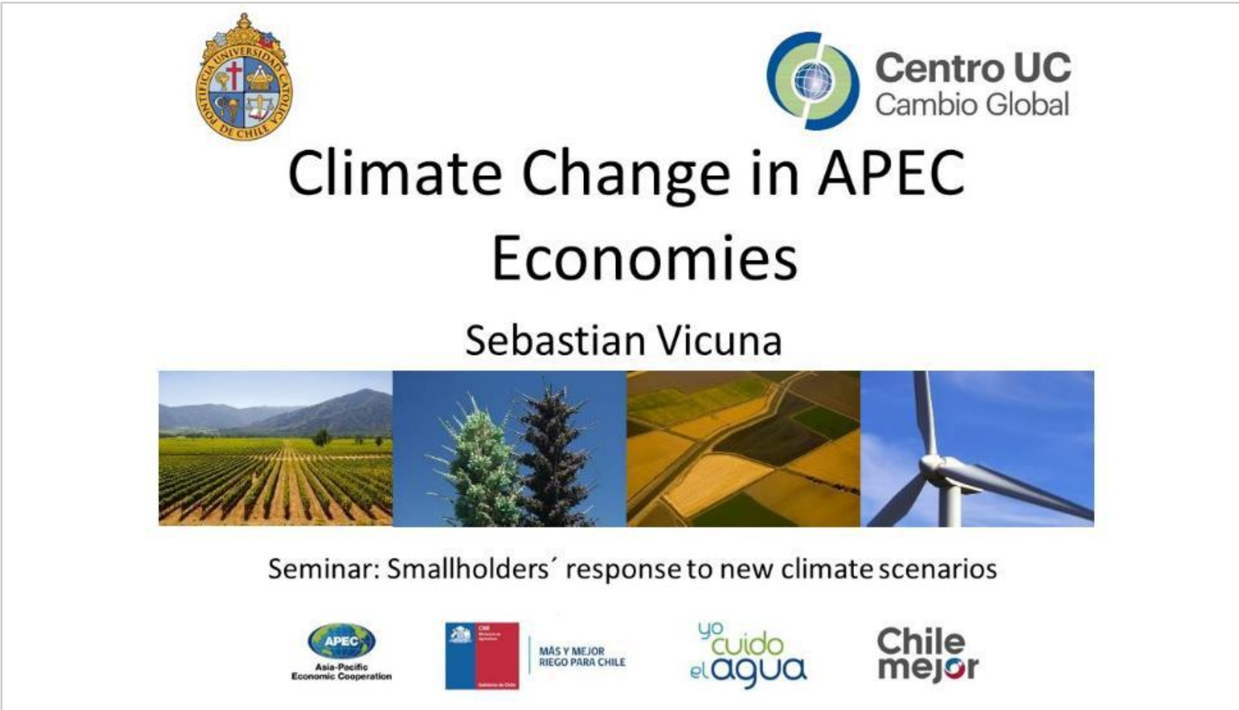
Sebastián Vicuña, Centro de Cambio Global UC, Pontificia Universidad Católica de Chile, Chile. Presentation: "Climate Change in a Global Context"



Contents

- Climate change and smallholders
- APEC countries and climate change

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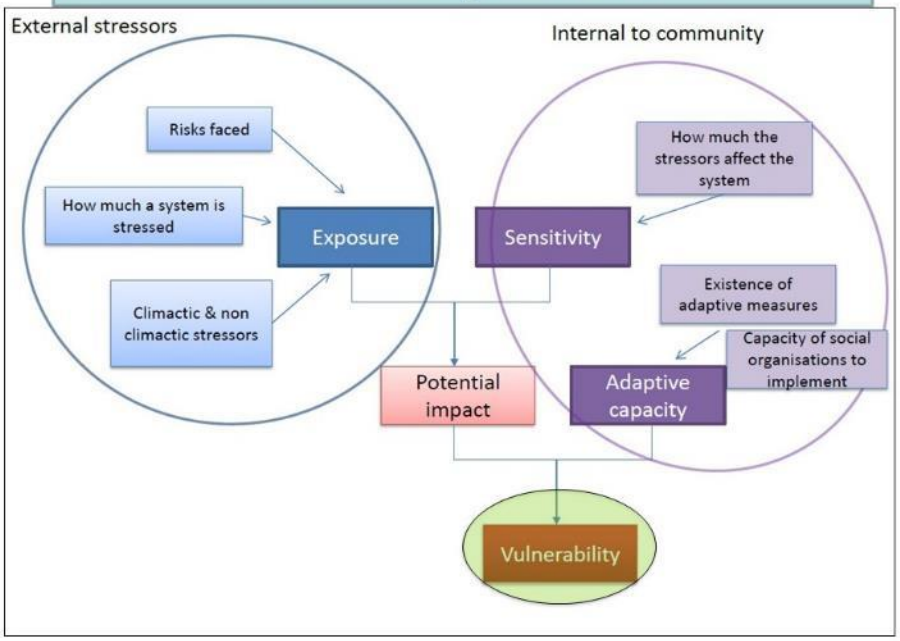
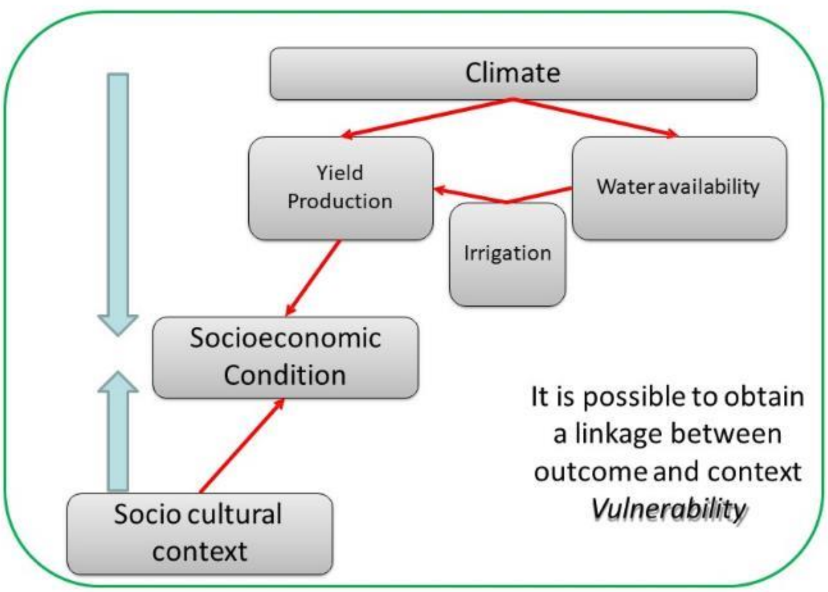
A Vulnerability Framework



Vulnerability: Agriculture context



The impact of climate change on smallholder and subsistente agricultura

(IPPC, 2014; Morton, 2007)

- Some of the most important impacts of global climate change will be felt among the populations, predominantly in developing countries, referred to as ''subsistence'' or ''smallholder'' farmers.
- Their vulnerability to climate change comes in part from various socioeconomic, demographic, and policy trends limiting their capacity to adapt to change.

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The impact of climate change on smallholder and subsistente agricultura

(IPPC, 2014; Morton, 2007)

- Smallholders are specially vulnerable to non climate-related stressor (under investment, land and natural resource policy, environmental degradation)
- Although their resilience (stemming from factors such as indigenous knowledge, family labor, livelihood diversification) should not be underestimated.

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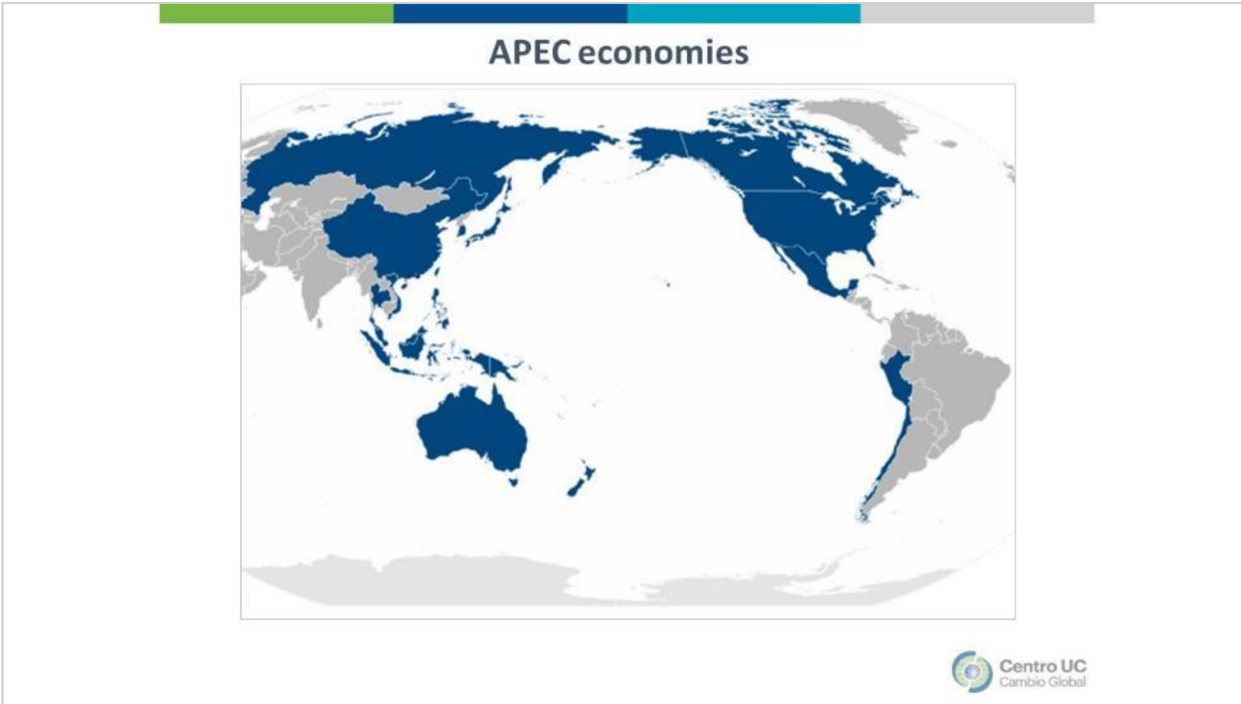
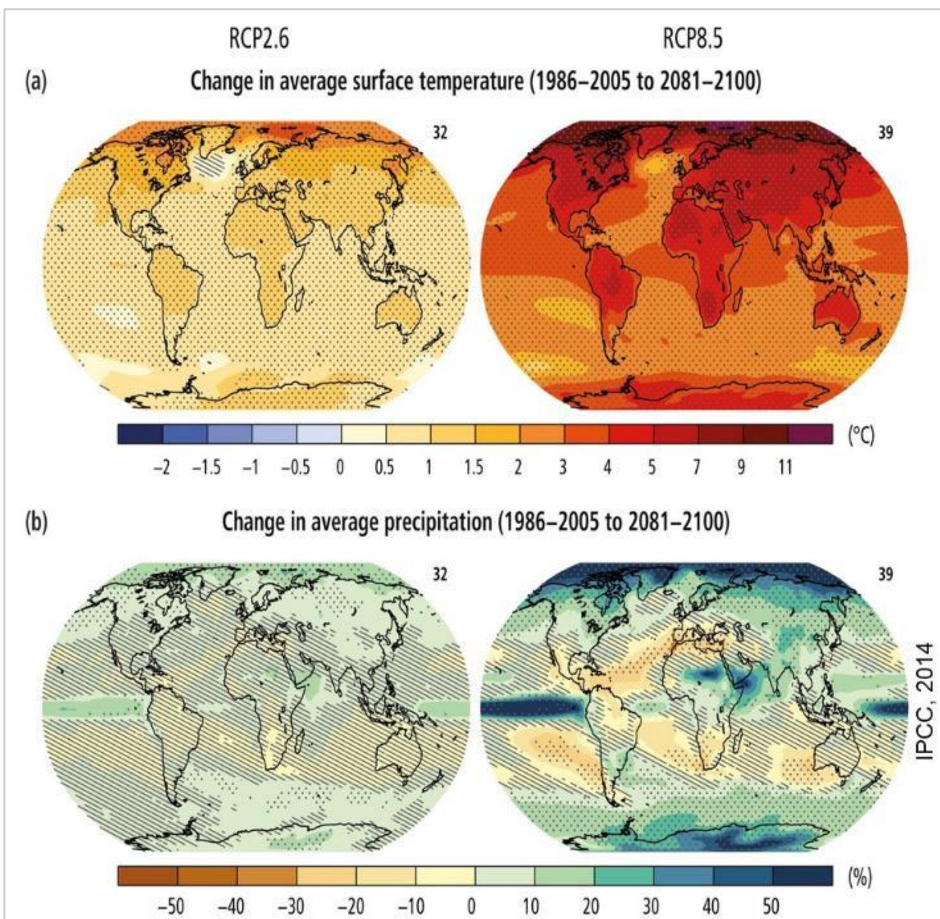
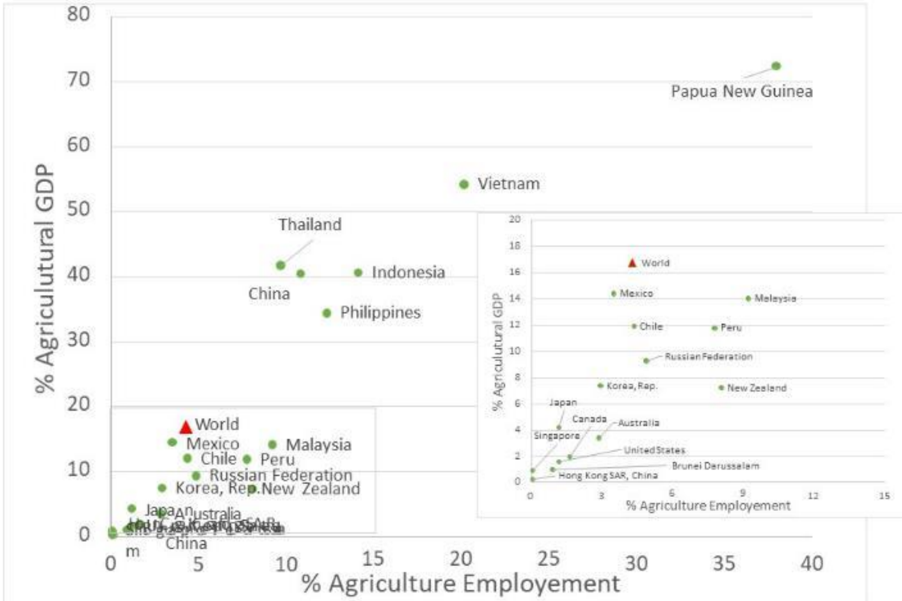
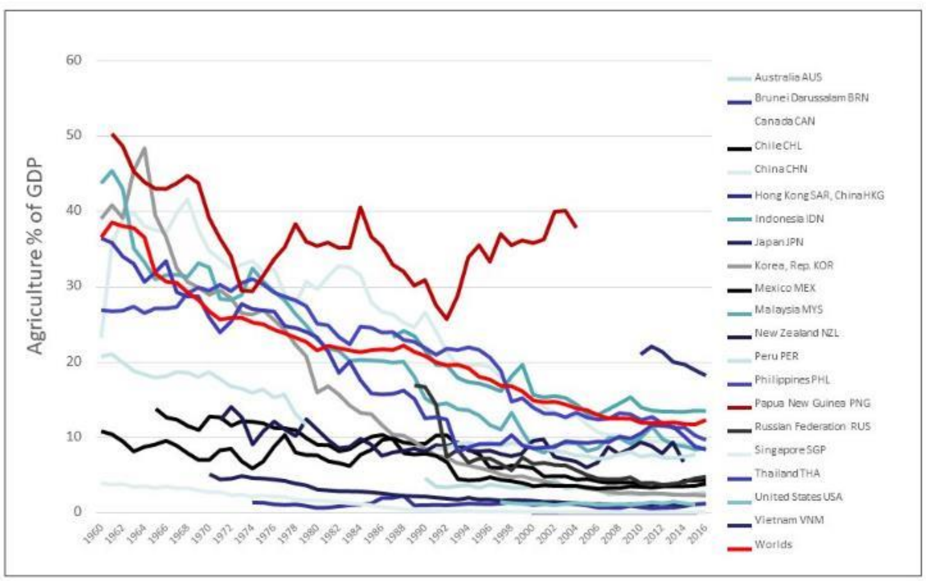

APEC economies
Centro UC
Cambio Global


RCP2.6
RCP8.5
(a)
Change in average surface temperature (1986–2005 to 2081–2100)
32
39
(°C)
−2 −1.5 −1 −0.5 0 0.5 1 1.5 2 3 4 5 7 9 11
(b)
Change in average precipitation (1986–2005 to 2081–2100)
32
39
IPCC, 2014
(%)
−50 −40 −30 −20 −10 0 10 20 30 40 50

Agriculture in APEC economies

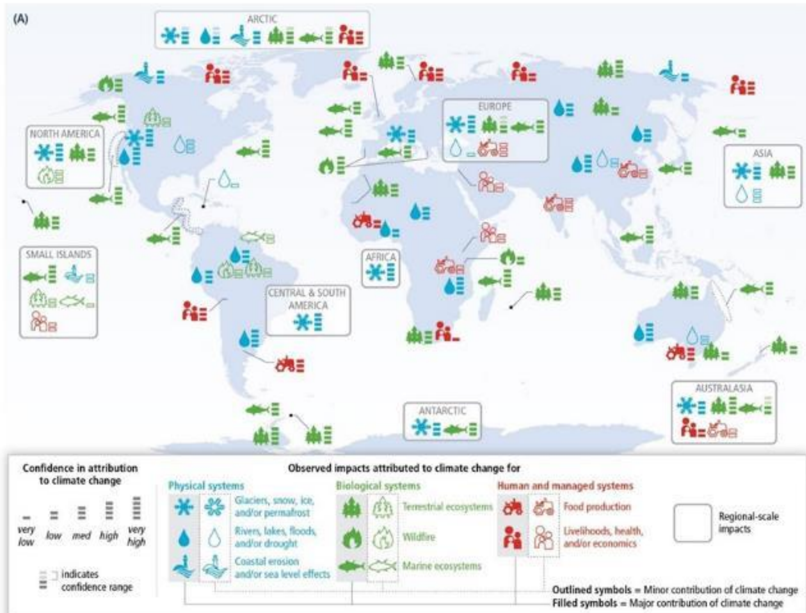


Agriculture in APEC economies



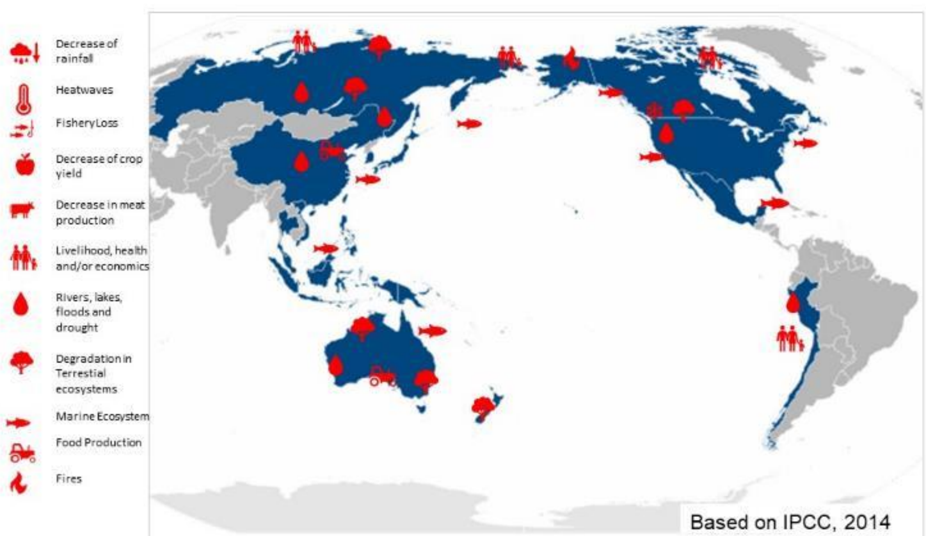
(World Bank national accounts data)

Observed Impacts of climate change

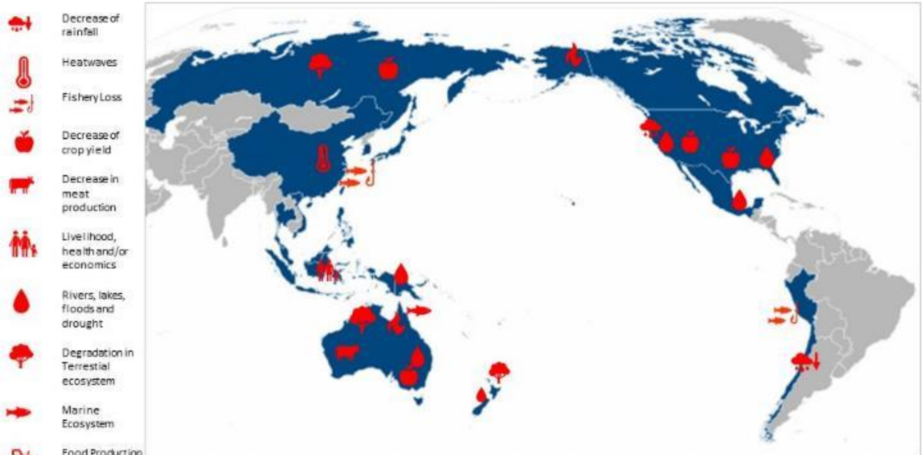


IPCC, 2014

APEC Economies – Observed Impacts of climate change scenarios



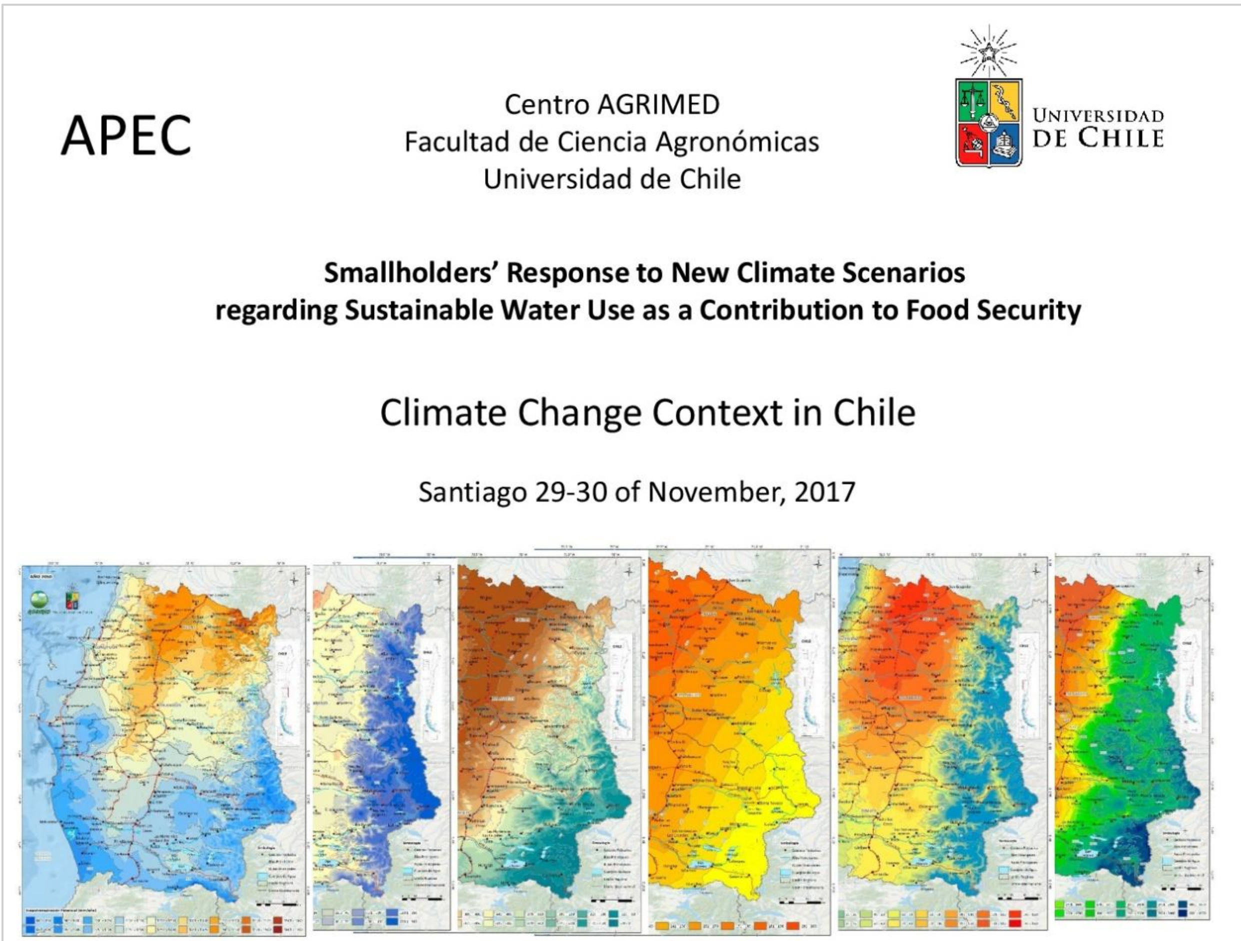
APEC Economies – Projected impacts of climate change

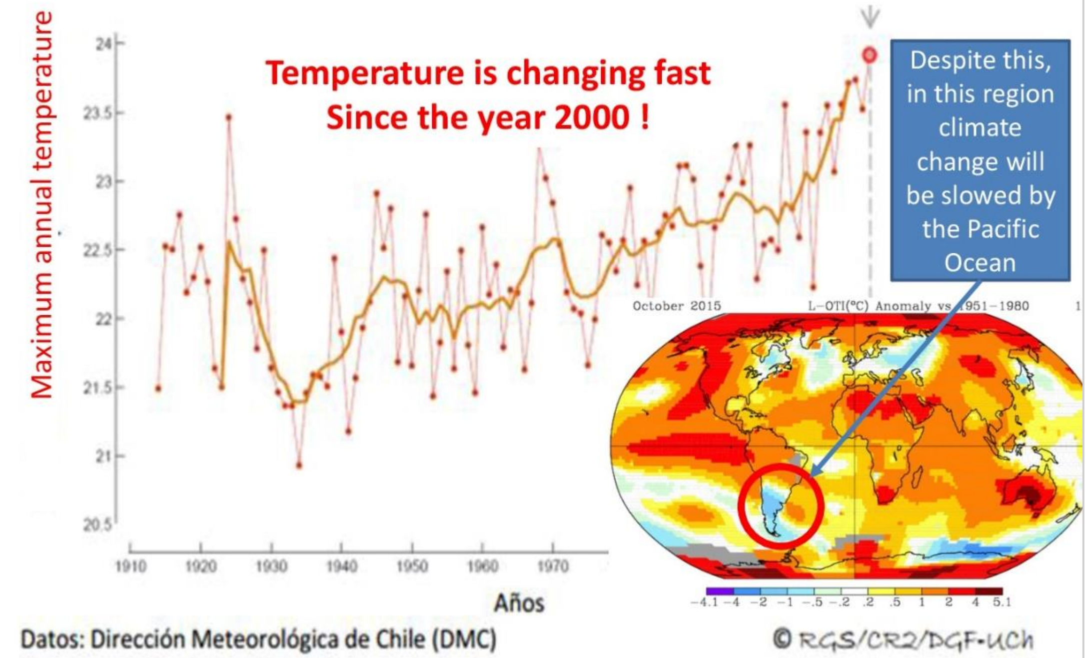


Based on IPCC regional chapters: Asia (Hijioka, et al 2014), Australasia (Reisinger, et al 2014), North America (Romero-Lankao et al, 2014) and Central and South America (Magrin et al., 2014)

Fernando Santibáñez, AGRIMED, Universidad de Chile, Chile

Presentación: Climate Change context in Chile





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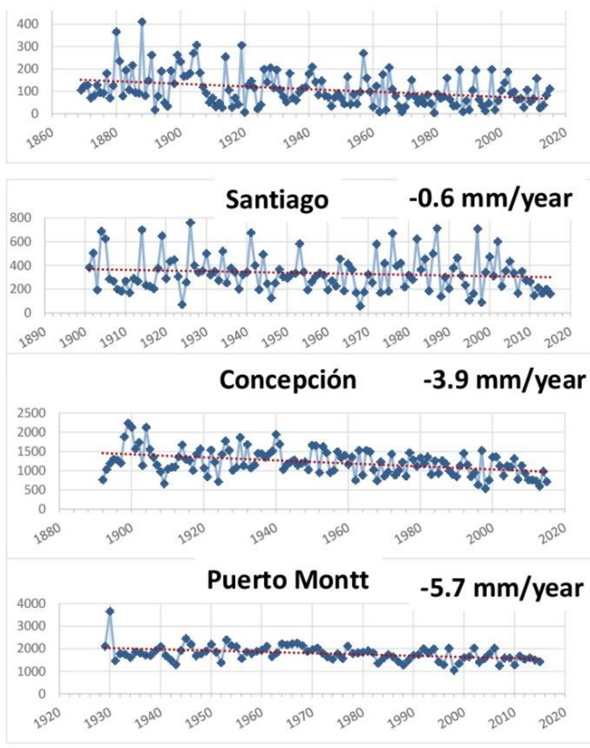
Annual rainfall has fallen about 20% during the 20th century

Climate Change Evidence In Chile



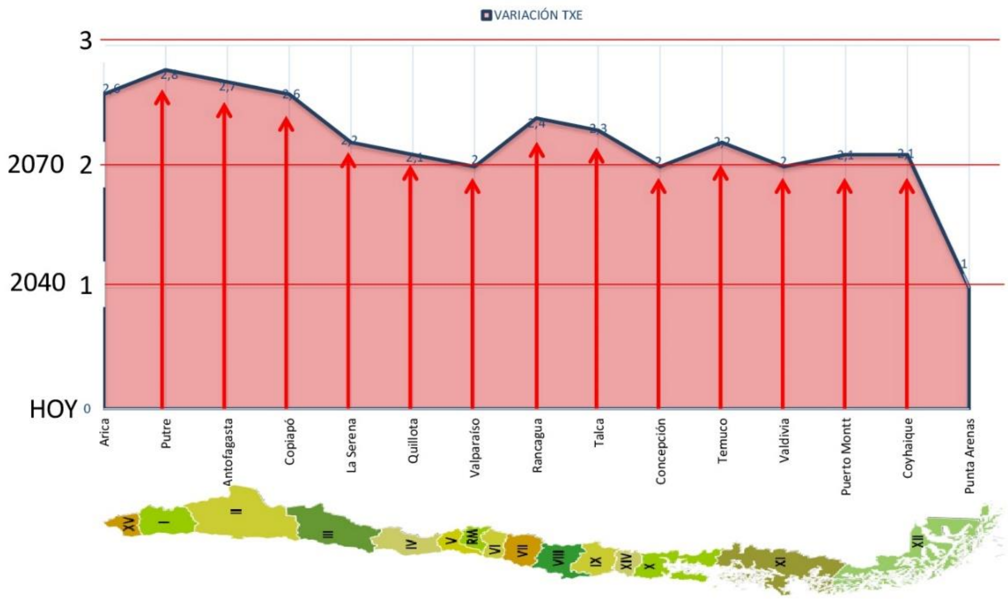
Anual rainfall has fallen about 20% in the last century.

Anual rainfall could drop by 20 to 30% along this century

Expected change on maximum temperature

+2°C is posible in the next decades

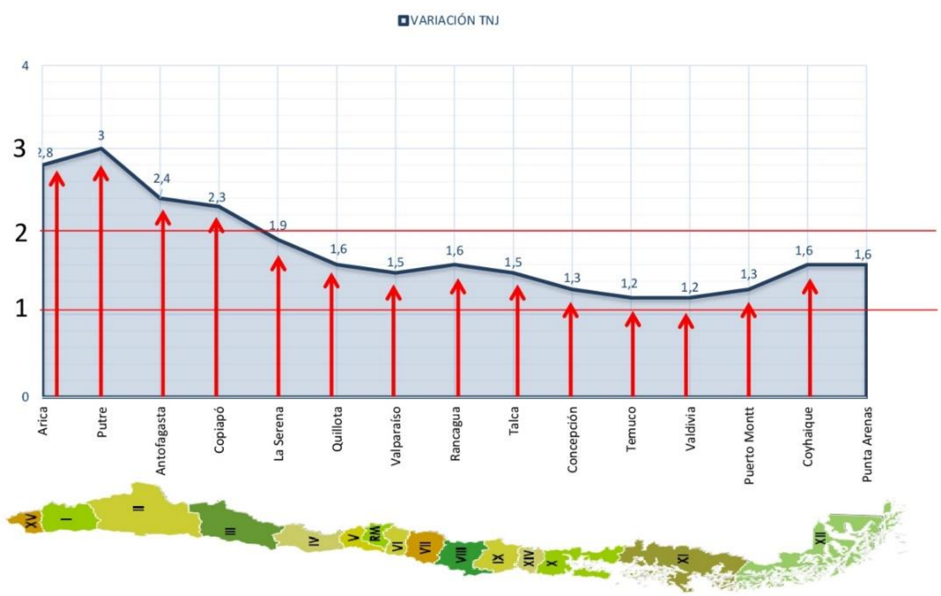
VARIACIÓN TXE (°C)



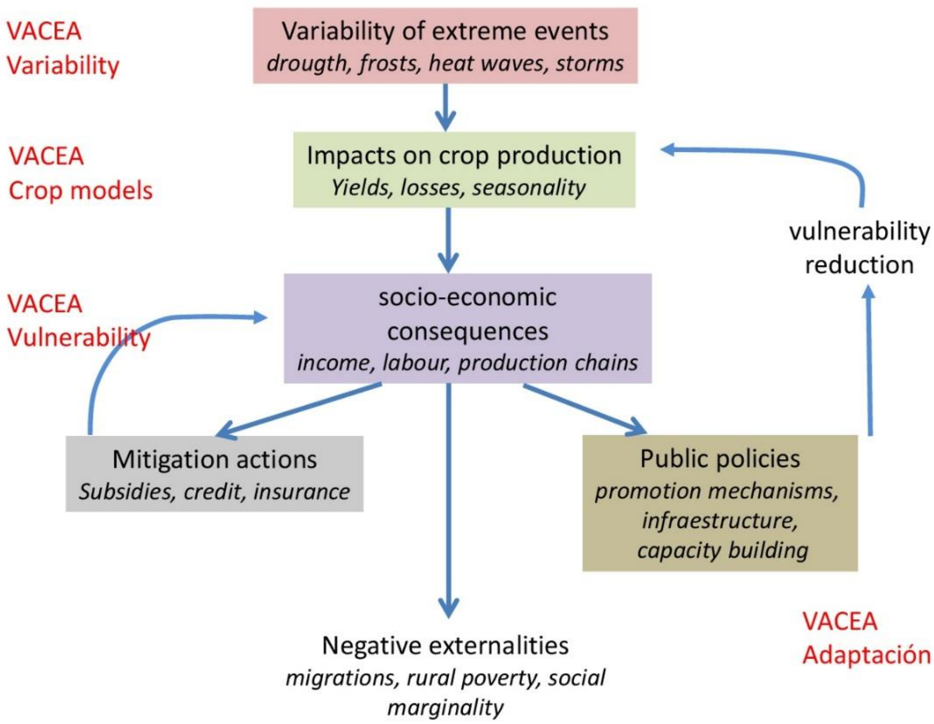
Expected change on mínimum temperatura

+1 to +2°C is posible in the next 5 decades

VARIACIÓN TNJ (°C)

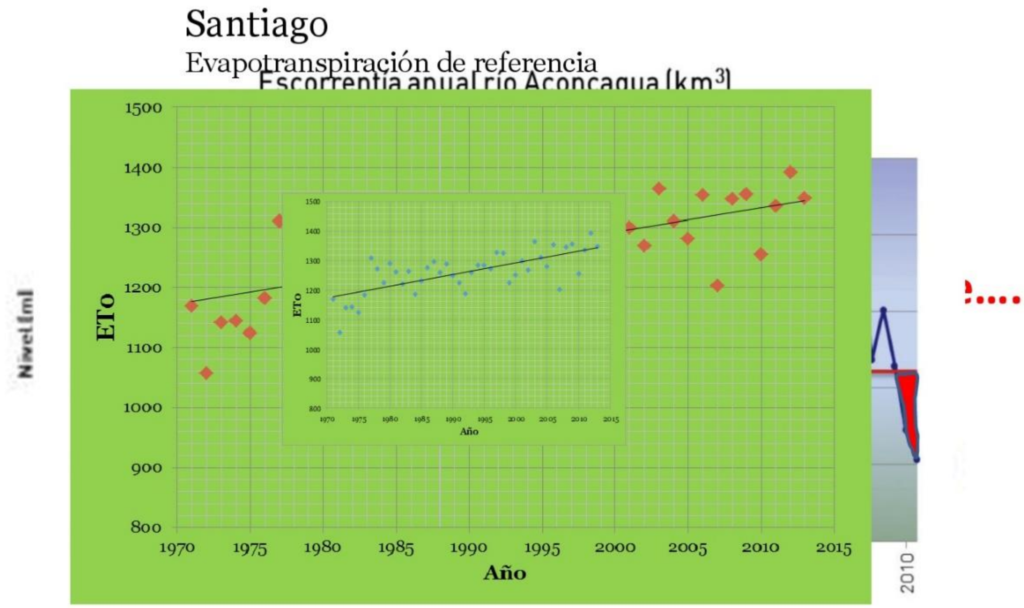


The path to the adaptation to a new climate context



The footprint of cimate change in Chile…..

Some of the signs…..



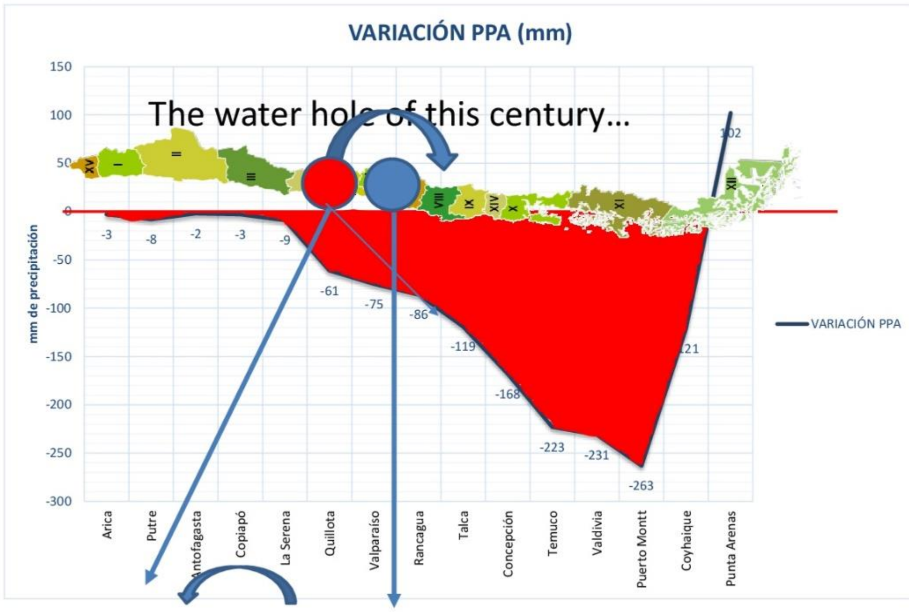
Stresed … going down….. … ation rates…..
Declining rainfall…..

To start an adaptation process, It is essential to answer the…..

¿What, when and where?..will happend

what changes will experience the climate?
which are the dimensions of those changes?
where the chages will be?
How climate changes will affect agriculture?

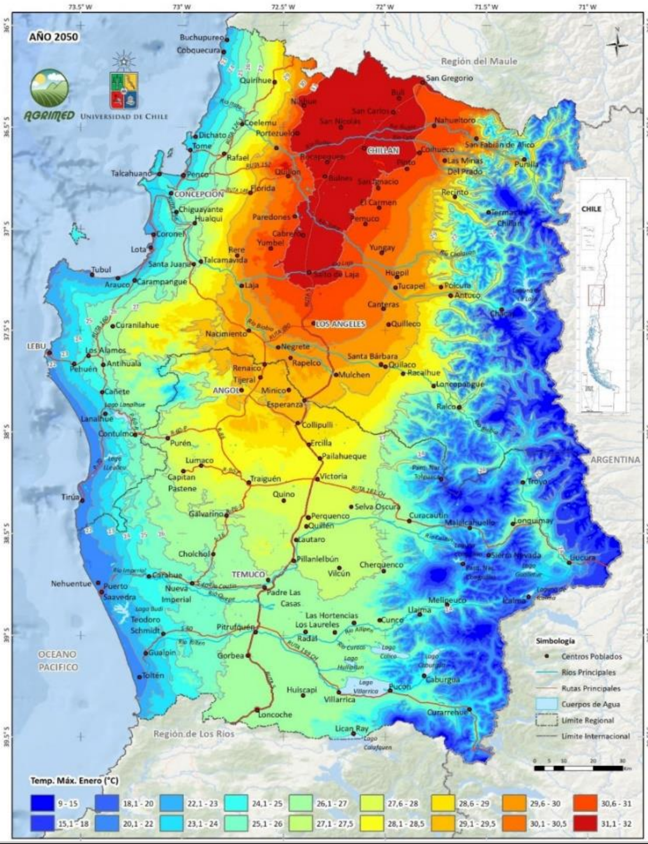
Expected variations on anual rainfall during this century



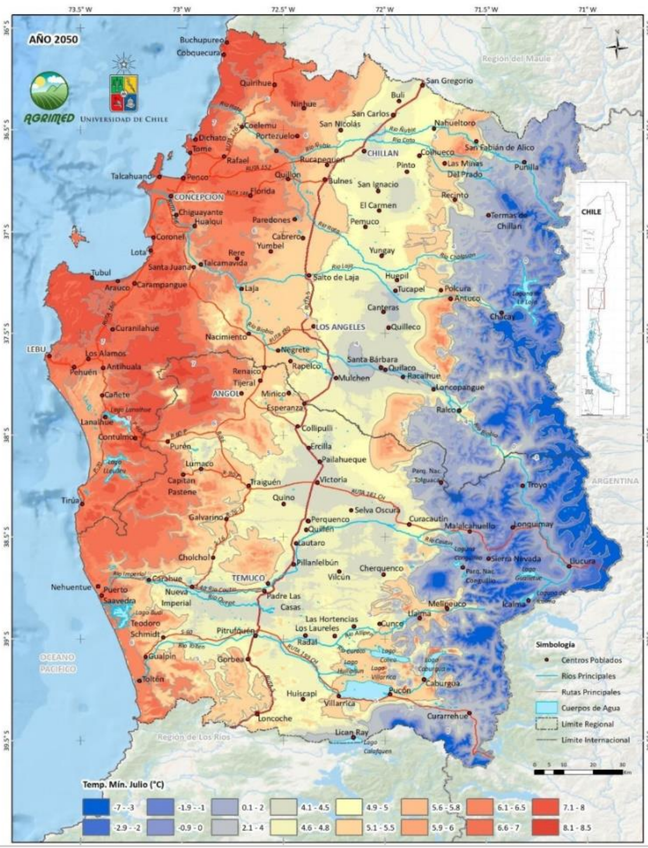
400 to 500
millions m3
is the present
wáter deficit

11 throusands millions of m3
are available mainly in winter

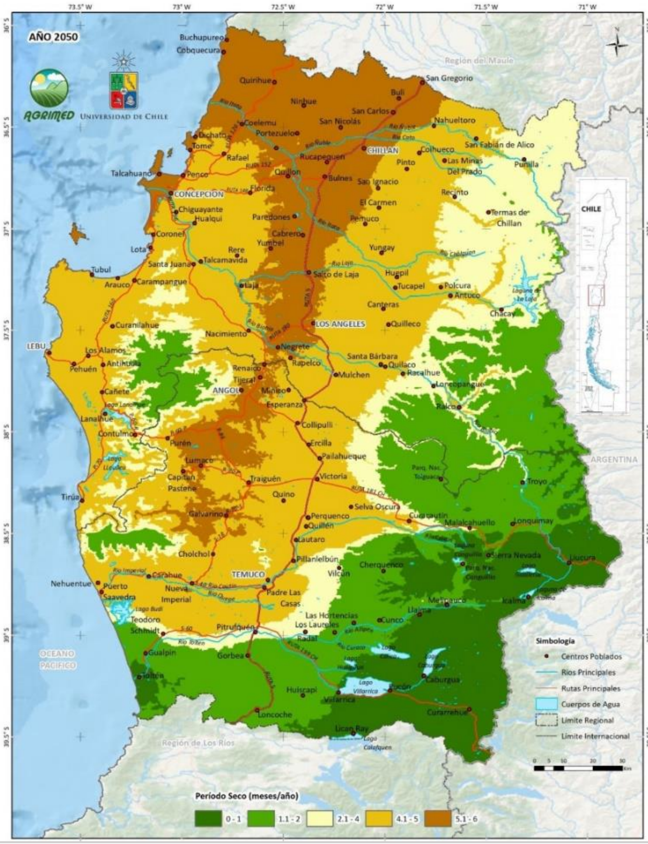
some progresses answering these questions



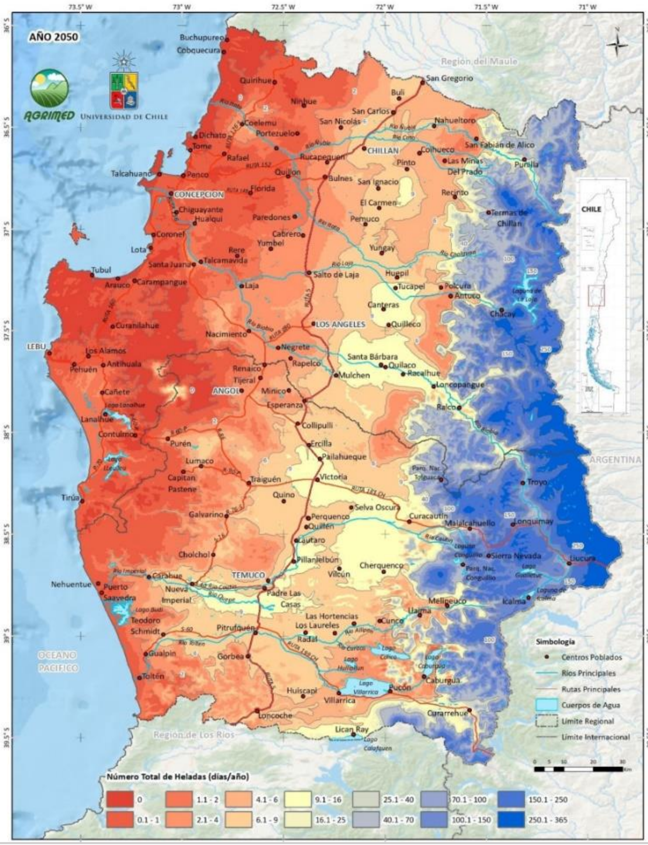
maximum
temperature of
the
warmest month



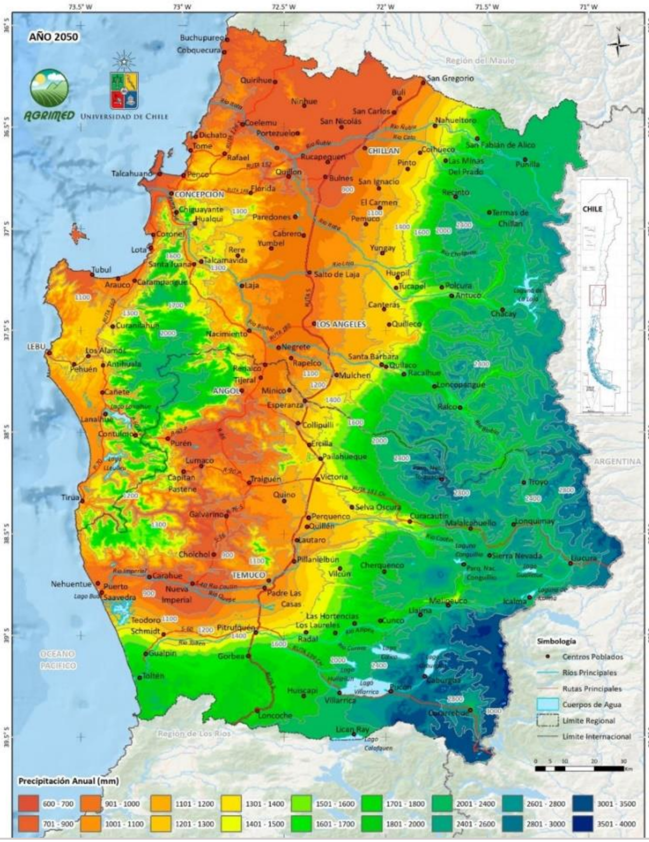
minimum
temperature of
the
coldest month



length of the dry period



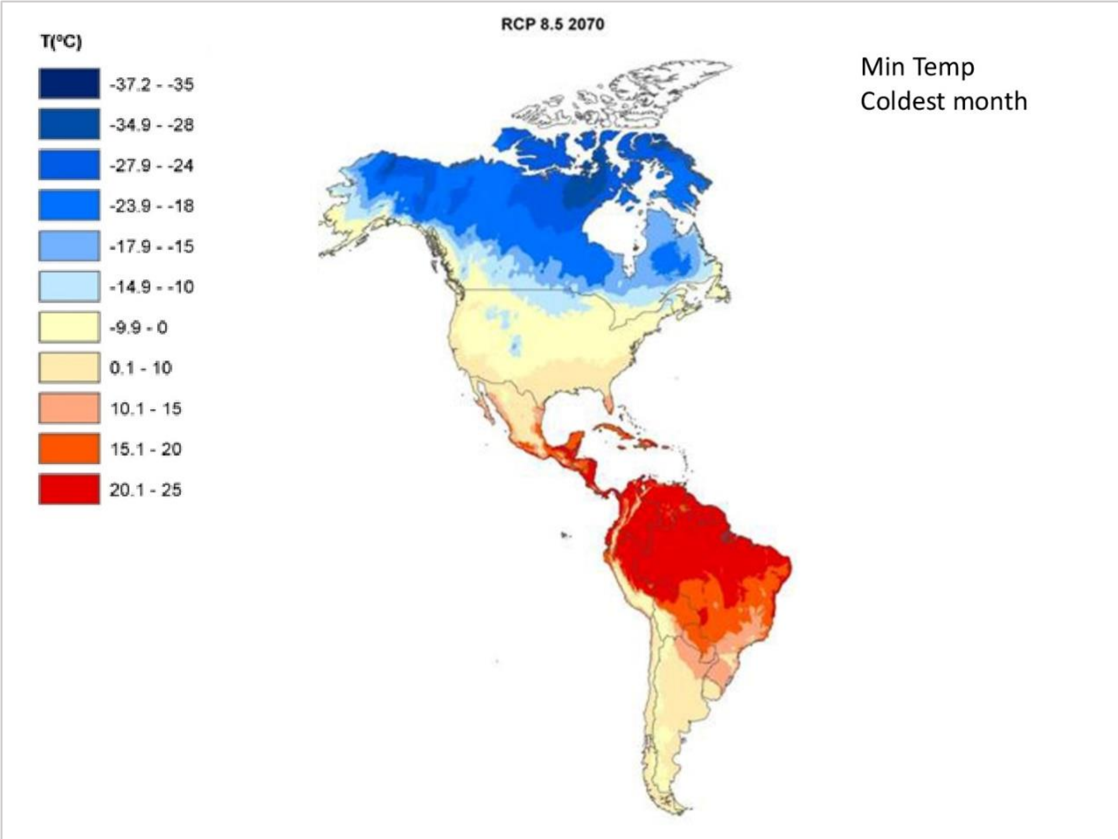
anual frost

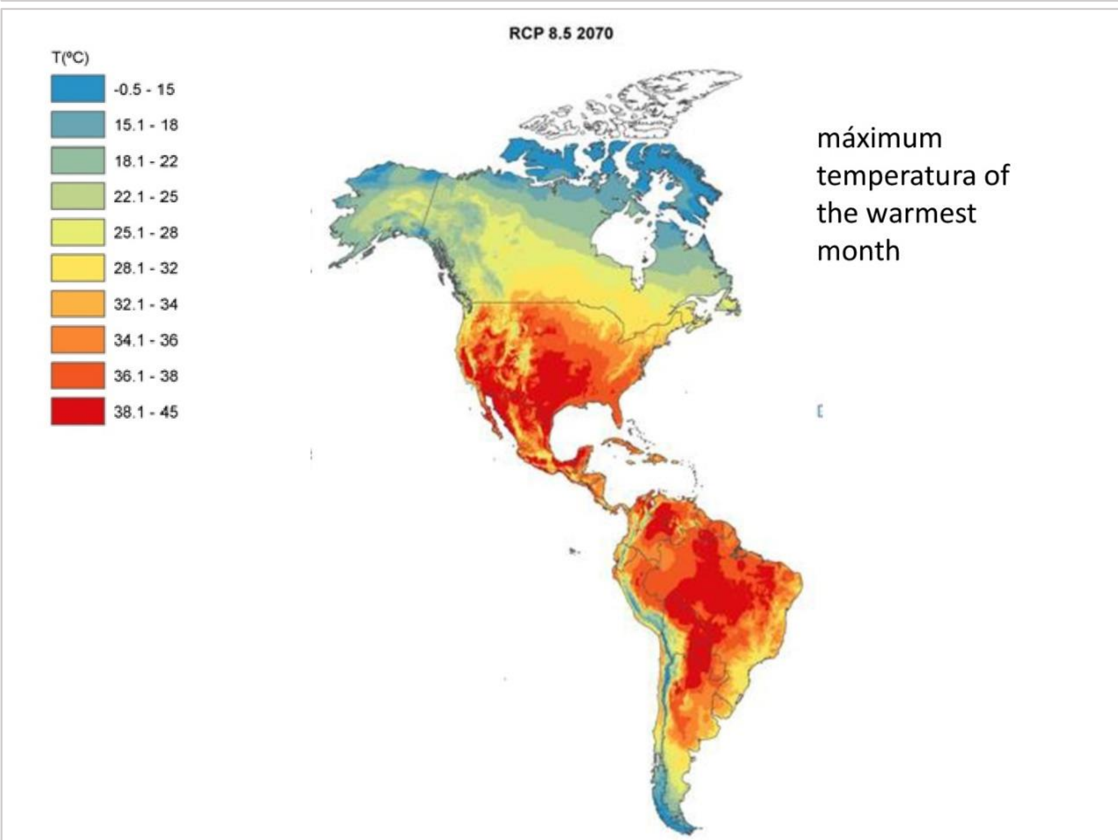


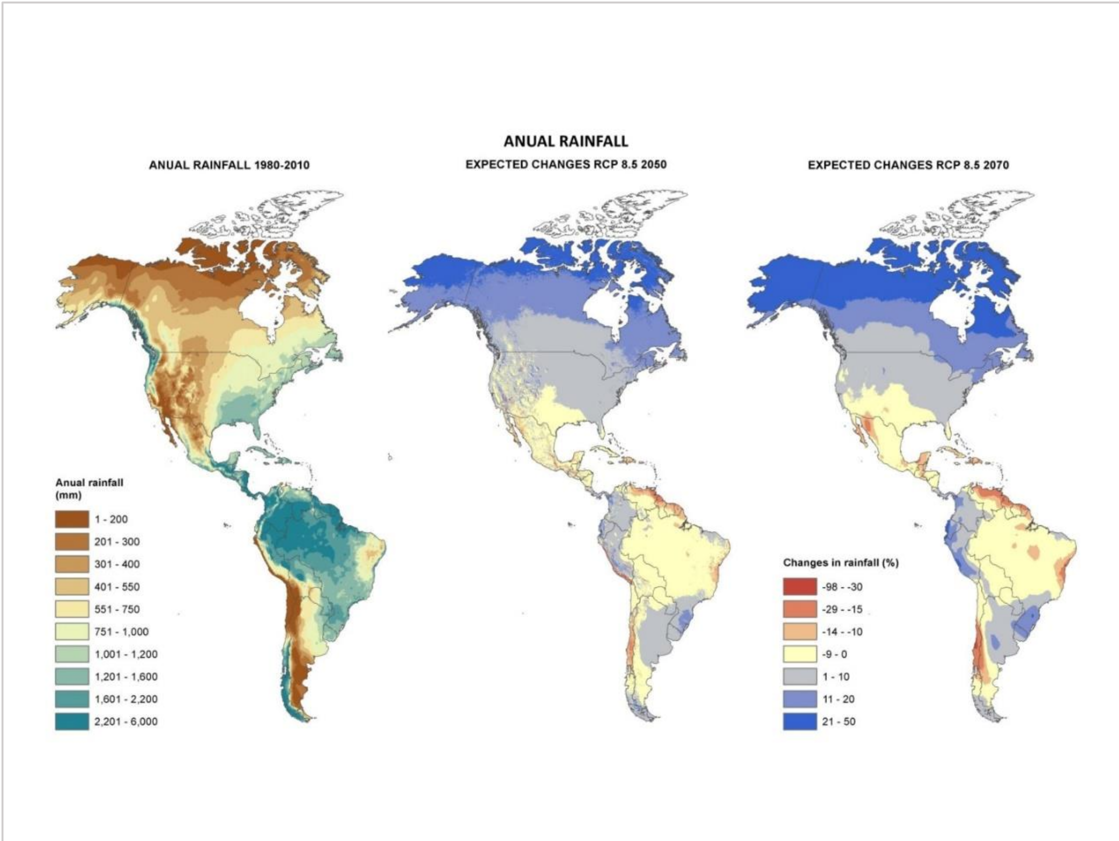
anual rainfall

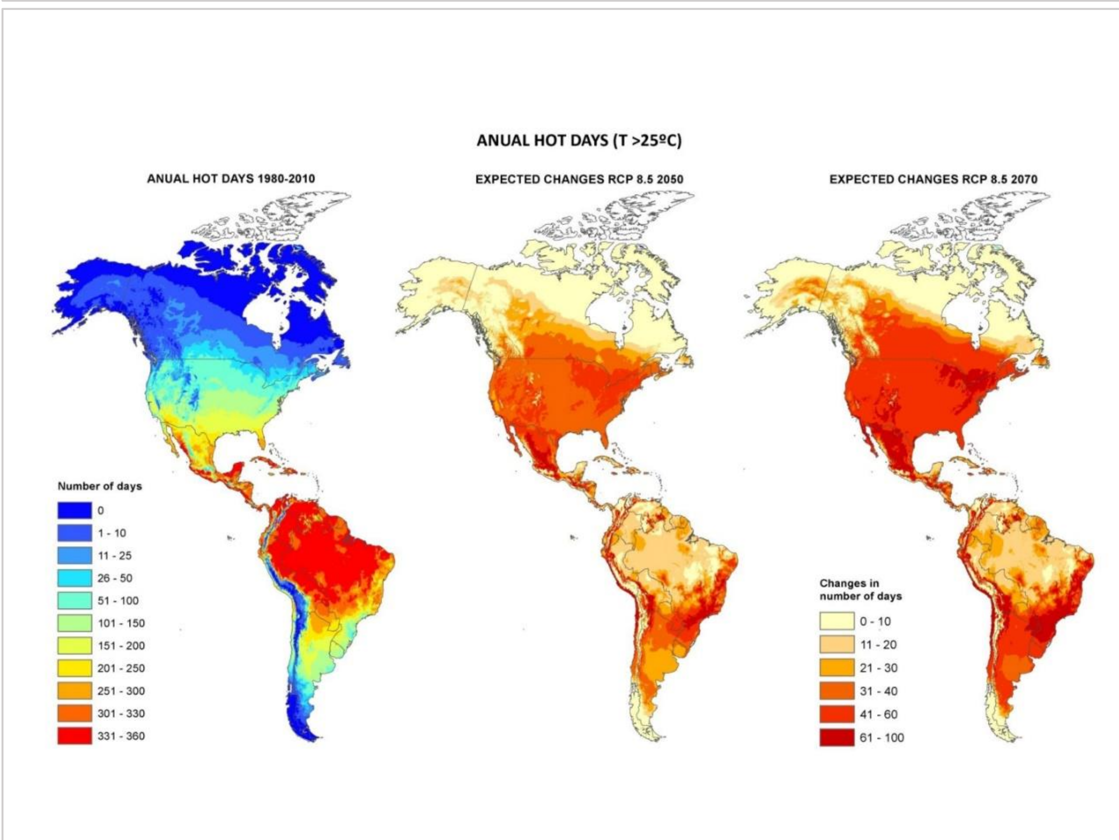
Climate change scenarios in the Americas

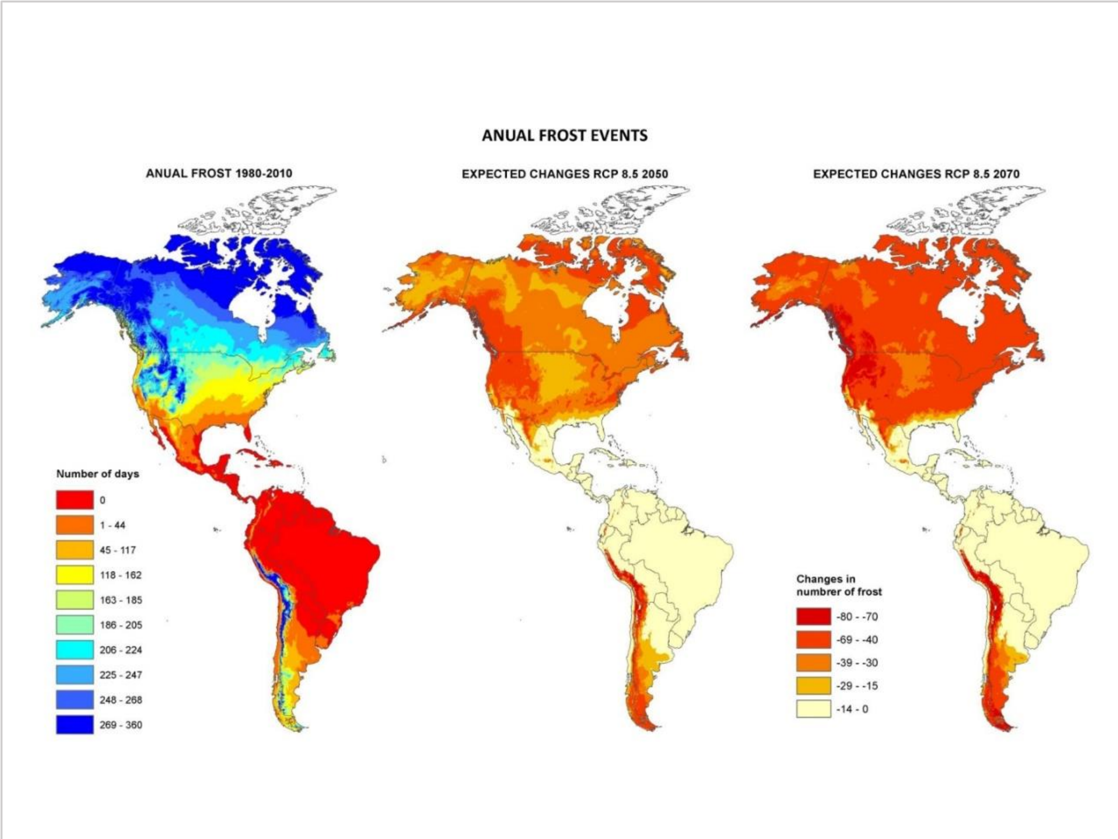
Projections over the American continent

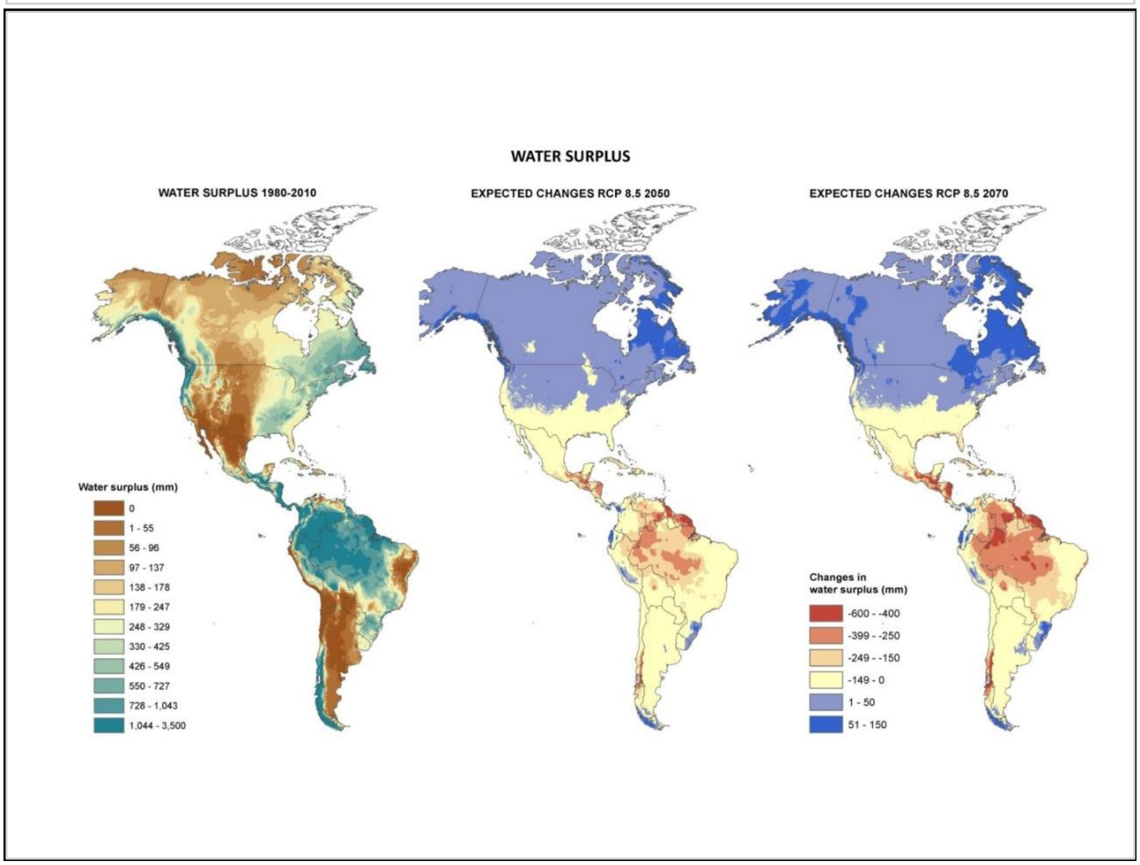

RCP 8.5 2070
T(ºC)
-37.2 - -35
-34.9 - -28
-27.9 - -24
-23.9 - -18
-17.9 - -15
-14.9 - -10
-9.9 - 0
0.1 - 10
10.1 - 15
15.1 - 20
20.1 - 25
Min Temp
Coldest month

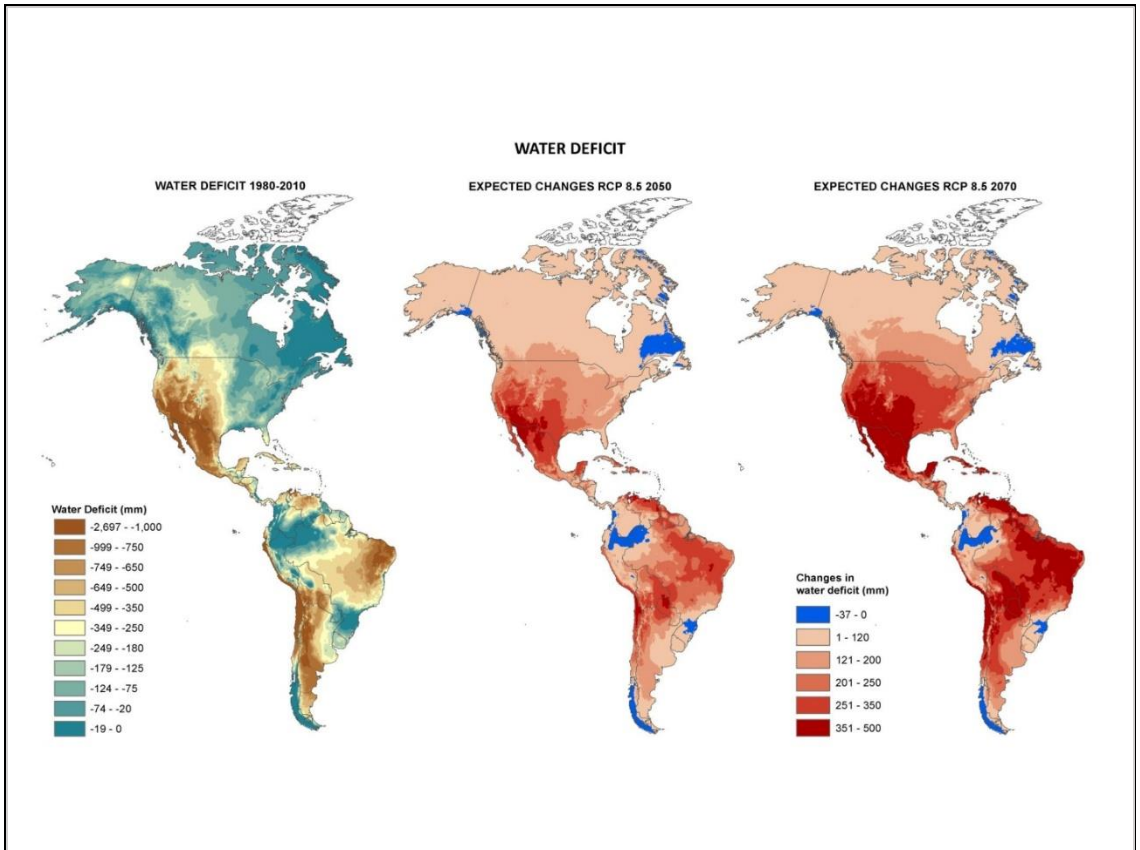

RCP 8.5 2070
T(ºC)
-0.5 - 15
15.1 - 18
18.1 - 22
22.1 - 25
25.1 - 28
28.1 - 32
32.1 - 34
34.1 - 36
36.1 - 38
38.1 - 45
máximum
temperatura of
the warmest
month

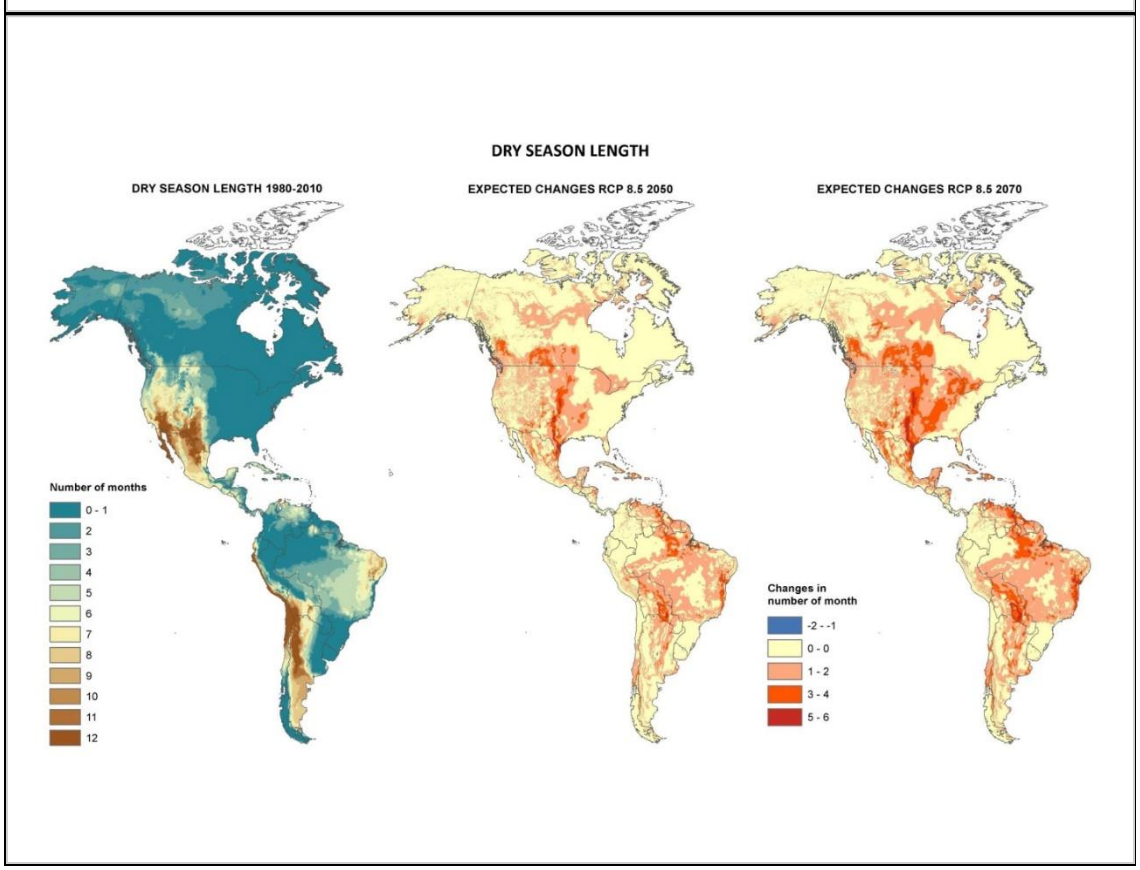

ANUAL RAINFALL
ANUAL RAINFALL 1980-2010
EXPECTED CHANGES RCP 8.5 2050
EXPECTED CHANGES RCP 8.5 2070
Anual rainfall (mm)
1 - 200
201 - 300
301 - 400
401 - 550
551 - 750
751 - 1,000
1,001 - 1,200
1,201 - 1,600
1,601 - 2,200
2,201 - 6,000
Changes in rainfall (%)
-98 - -30
-29 - -15
-14 - -10
-9 - 0
1 - 10
11 - 20
21 - 50

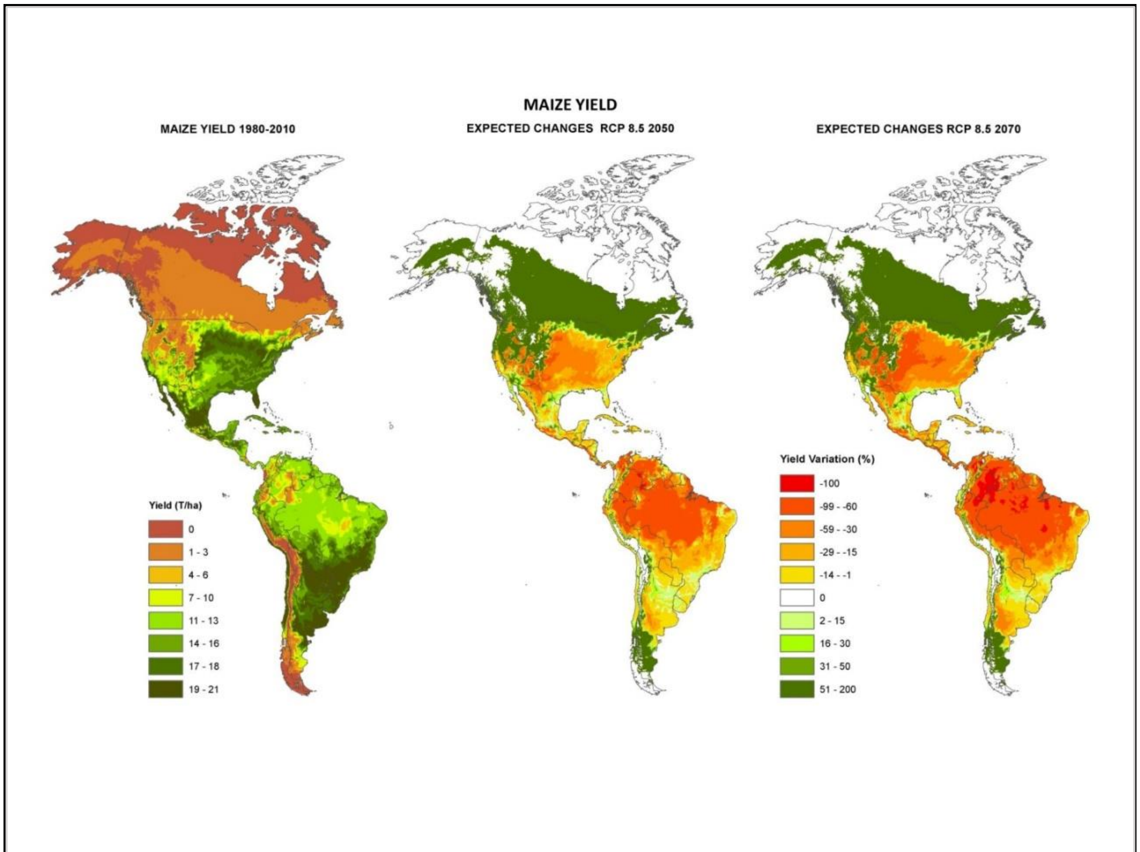

ANUAL HOT DAYS (T >25ºC)
ANUAL HOT DAYS 1980-2010
EXPECTED CHANGES RCP 8.5 2050
EXPECTED CHANGES RCP 8.5 2070
Number of days
0
1 - 10
11 - 25
26 - 50
51 - 100
101 - 150
151 - 200
201 - 250
251 - 300
301 - 330
331 - 360
Changes in number of days
0 - 10
11 - 20
21 - 30
31 - 40
41 - 60
61 - 100

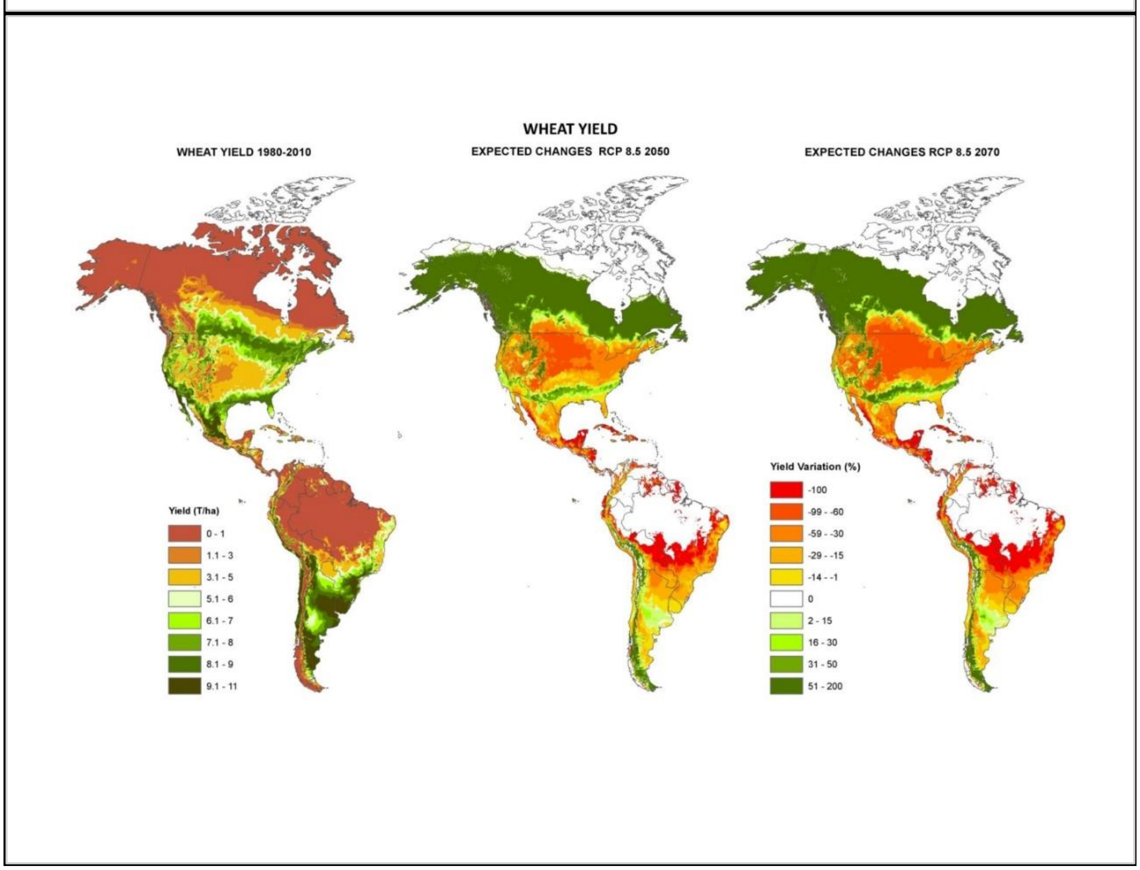

ANUAL FROST EVENTS
ANUAL FROST 1980-2010
EXPECTED CHANGES RCP 8.5 2050
EXPECTED CHANGES RCP 8.5 2070
Number of days
0
1 - 44
45 - 117
118 - 162
163 - 185
186 - 205
206 - 224
225 - 247
248 - 268
269 - 360
Changes in numbrer of frost
-80 - -70
-69 - -40
-39 - -30
-29 - -15
-14 - 0

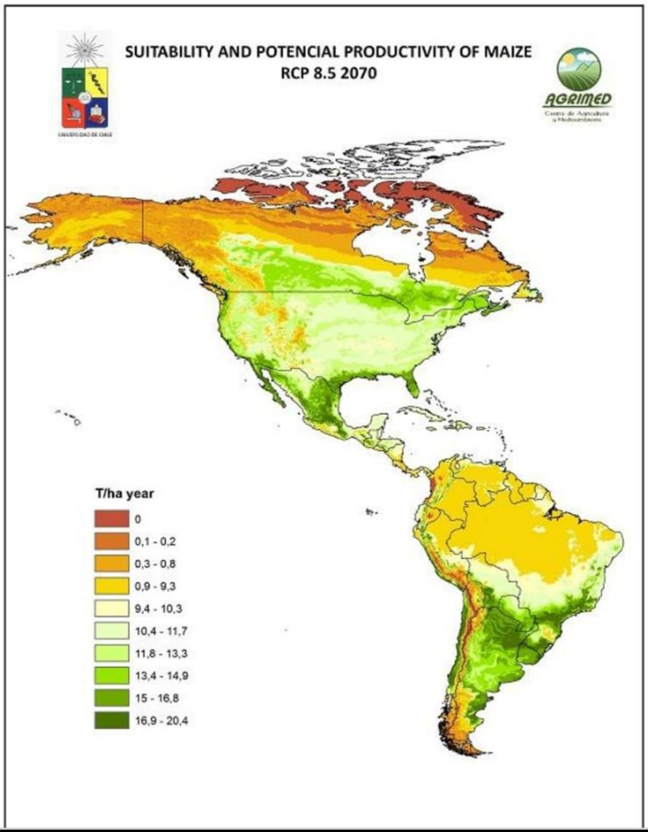

WATER SURPLUS
WATER SURPLUS 1980-2010
EXPECTED CHANGES RCP 8.5 2050
EXPECTED CHANGES RCP 8.5 2070
Water surplus (mm)
0
1 - 55
56 - 96
97 - 137
138 - 178
179 - 247
248 - 329
330 - 425
426 - 549
550 - 727
728 - 1,043
1,044 - 3,500
Changes in water surplus (mm)
-600 - -400
-399 - -250
-249 - -150
-149 - 0
1 - 50
51 - 150

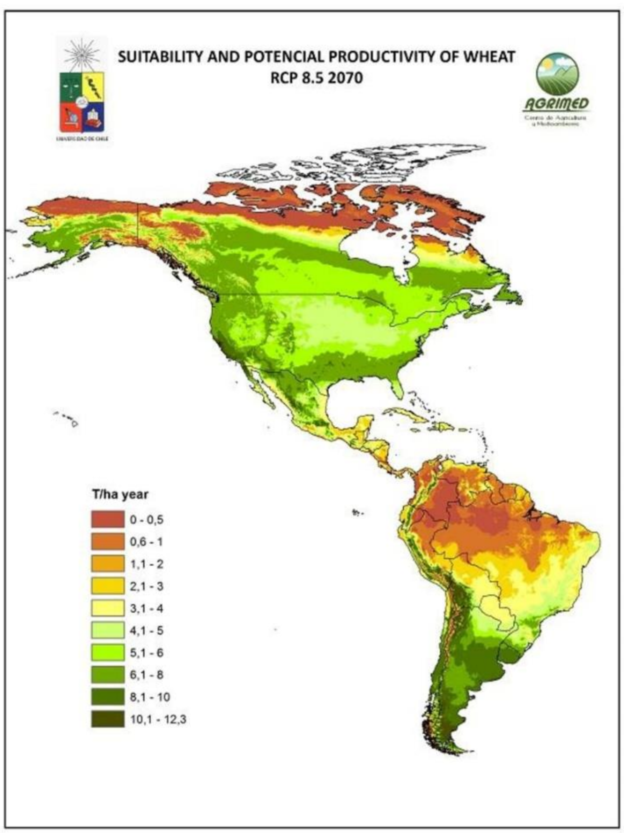

WATER DEFICIT
WATER DEFICIT 1980-2010
EXPECTED CHANGES RCP 8.5 2050
EXPECTED CHANGES RCP 8.5 2070
Water Deficit (mm)
-2,697 - -1,000
-999 - -750
-749 - -650
-649 - -500
-499 - -350
-349 - -250
-249 - -180
-179 - -125
-124 - -75
-74 - -20
-19 - 0
Changes in water deficit (mm)
-37 - 0
1 - 120
121 - 200
201 - 250
251 - 350
351 - 500


DRY SEASON LENGTH
DRY SEASON LENGTH 1980-2010
EXPECTED CHANGES RCP 8.5 2050
EXPECTED CHANGES RCP 8.5 2070
Number of months
0 - 1
2
3
4
5
6
7
8
9
10
11
12
Changes in number of month
-2 - -1
0 - 0
1 - 2
3 - 4
5 - 6

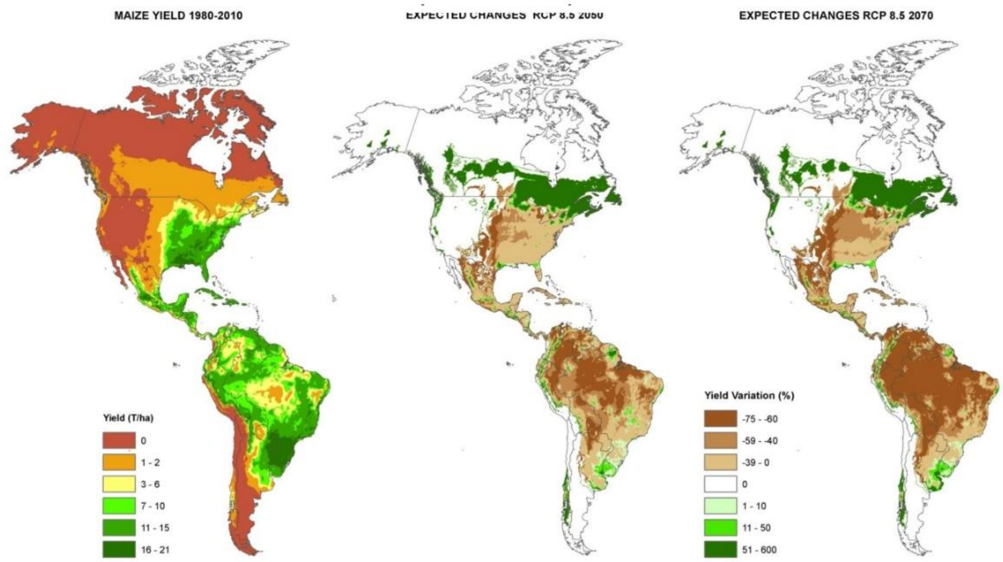

MAIZE YIELD
MAIZE YIELD 1980-2010
EXPECTED CHANGES RCP 8.5 2050
EXPECTED CHANGES RCP 8.5 2070
Yield (T/ha)
0
1 - 3
4 - 6
7 - 10
11 - 13
14 - 16
17 - 18
19 - 21
Yield Variation (%)
-100
-99 - -60
-59 - -30
-29 - -15
-14 - -1
0
2 - 15
16 - 30
31 - 50
51 - 200


WHEAT YIELD
WHEAT YIELD 1980-2010
EXPECTED CHANGES RCP 8.5 2050
EXPECTED CHANGES RCP 8.5 2070
Yield (T/ha)
0 - 1
1.1 - 3
3.1 - 5
5.1 - 6
6.1 - 7
7.1 - 8
8.1 - 9
9.1 - 11
Yield Variation (%)
-100
-99 - -60
-59 - -30
-29 - -15
-14 - -1
0
2 - 15
16 - 30
31 - 50
51 - 200

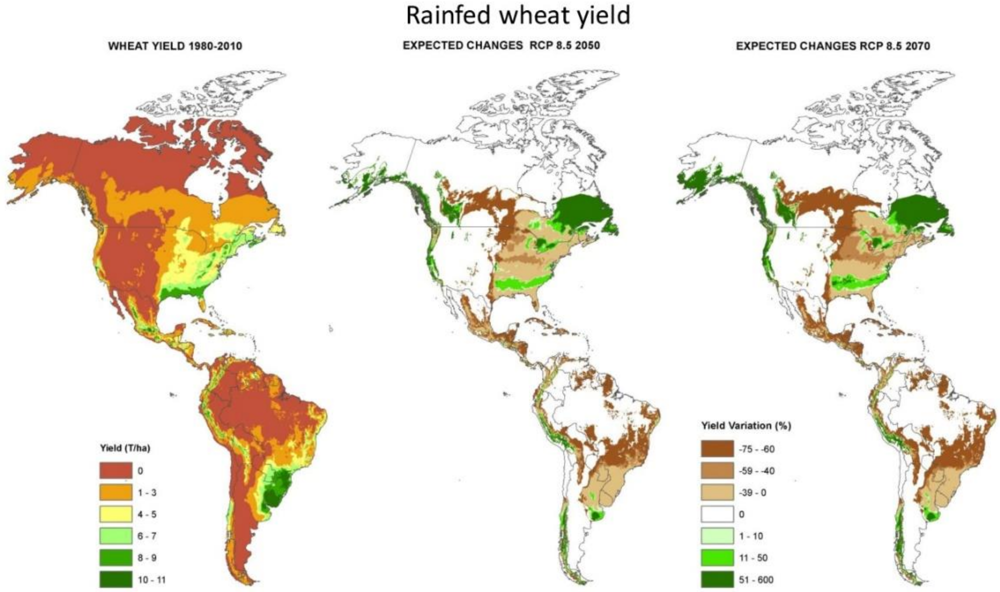

SUITABILITY AND POTENCIAL PRODUCTIVITY OF MAIZE
RCP 8.5 2070
AGRIMED
T/ha year
0
0,1 - 0,2
0,3 - 0,8
0,9 - 9,3
9,4 - 10,3
10,4 - 11,7
11,8 - 13,3
13,4 - 14,9
15 - 16,8
16,9 - 20,4


SUITABILITY AND POTENCIAL PRODUCTIVITY OF WHEAT
RCP 8.5 2070
AGRIMED
T/ha year
0 - 0,5
0,6 - 1
1,1 - 2
2,1 - 3
3,1 - 4
4,1 - 5
5,1 - 6
6,1 - 8
8,1 - 10
10,1 - 12,3

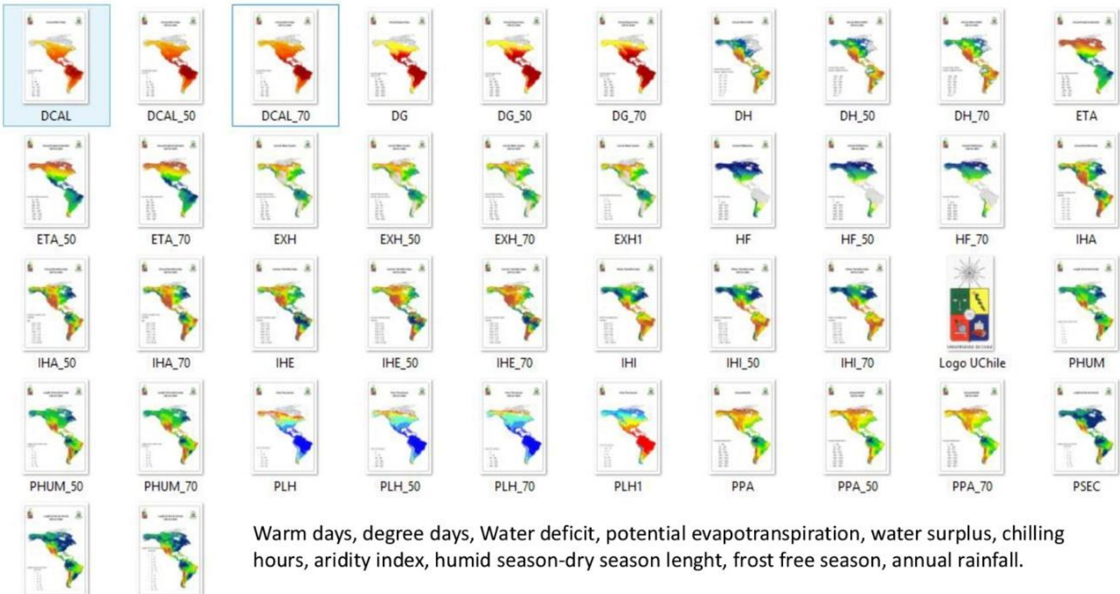
rainfed corn production



Rainfed wheat yield



Climate change scenarios on high resolution (Ensamble made with three selected models for RCP 8.5). VACEA project, AGRIMED, University of Chile



Warm days, degree days, Water deficit, potential evapotranspiration, water surplus, chilling hours, aridity index, humid season-dry season lenght, frost free season, annual rainfall.

There are many uncertainties that climate change will create:

Yields	Could fall due to thermal stress forcing technological changes
Water consumption	Could increase due to higher evapotranspiration rates
Products quality	Problems that are currently occasional may be intensified: sunburn, browning, softening, dehydration.
Sanitary context	Problems could intensify due to the increase in insect and microbial populations and inocula .

Some technological changes for adaptation

Anti-stress protection system (mesh, blankets, chemical screens, windbreaks

Agriculture in controlled environments

Land use changes, new emerging areas

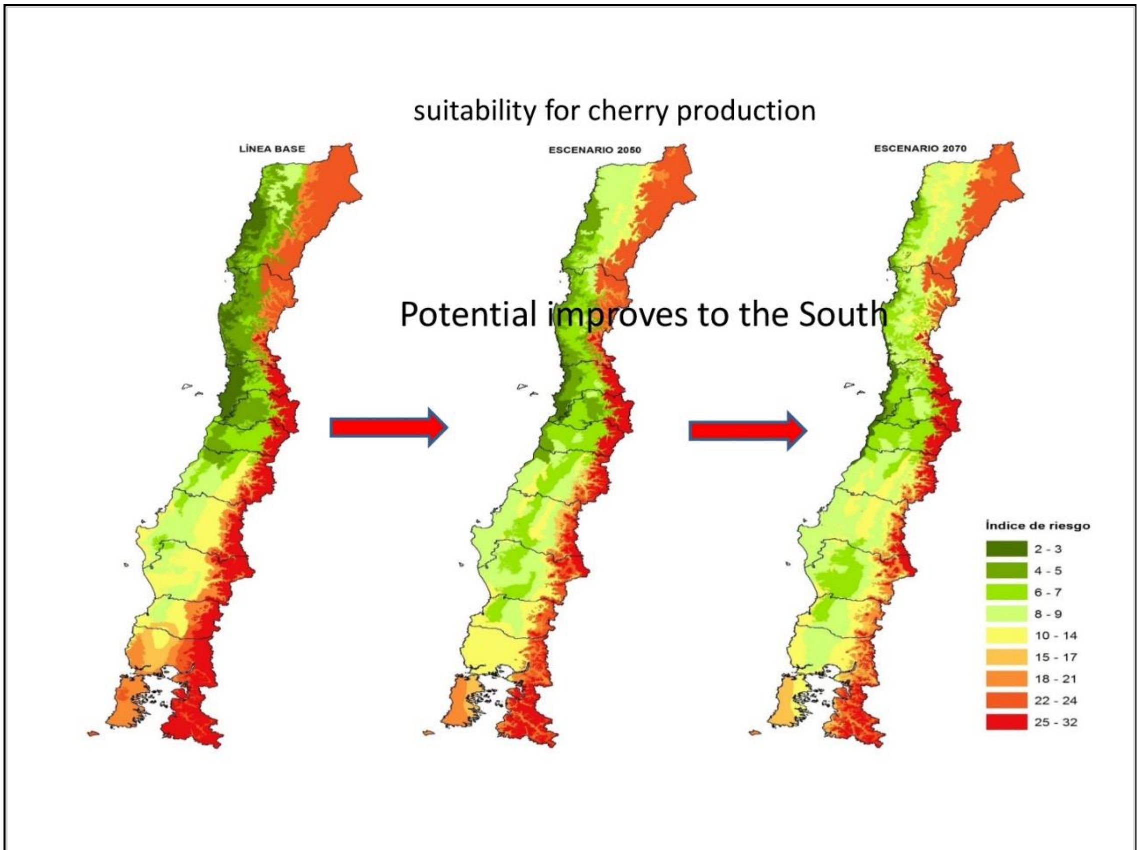
Highly efficient irrigation systems

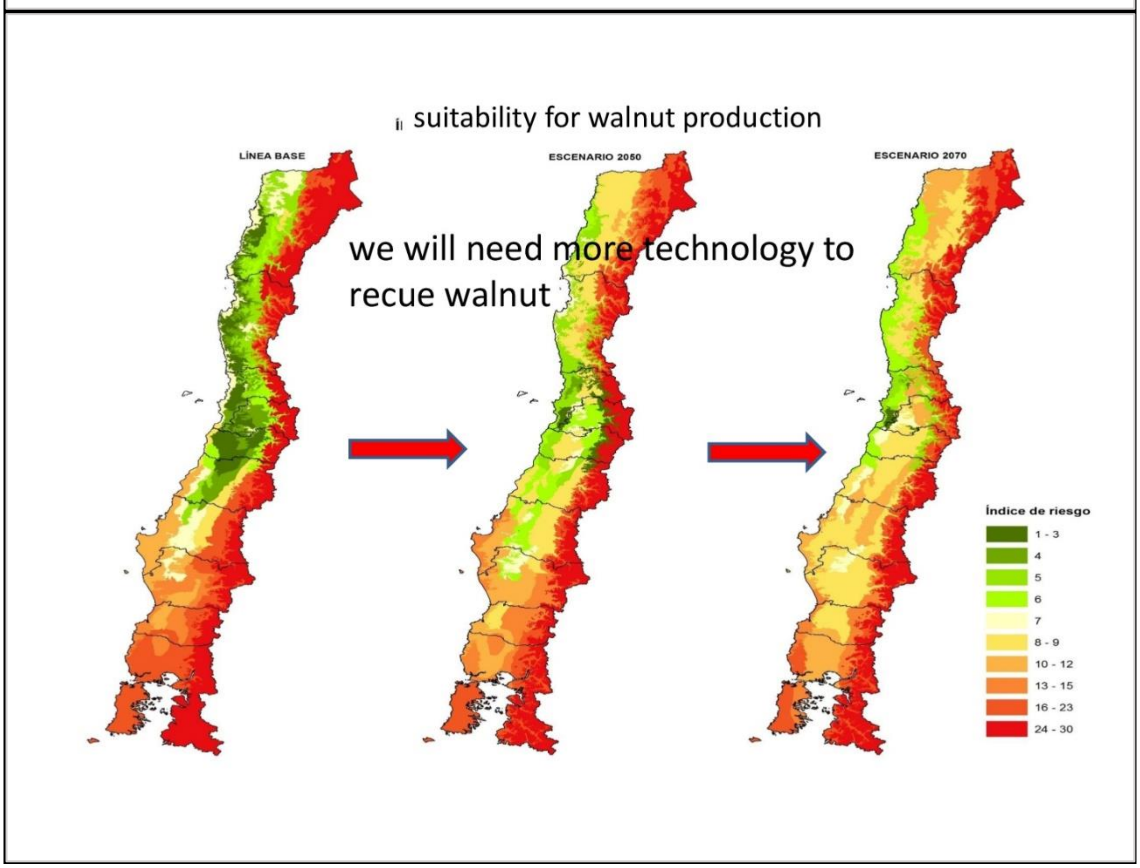
Agroclimatic risk management

New more resistent to physical stress varieties

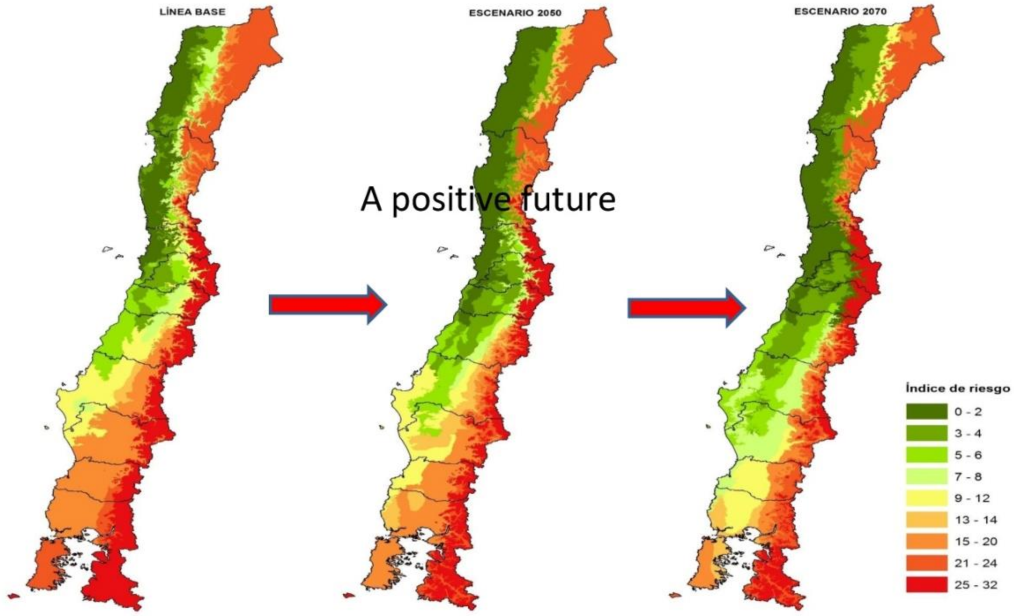
Impacts on agricultural potential in Chile: the good and the bad sides

VACEA project has made an important effort in calibrating the SIMPROC model for the whole continent, in order to have an evaluation tool to foresee the changes in climatic suitability for different cultivated species.

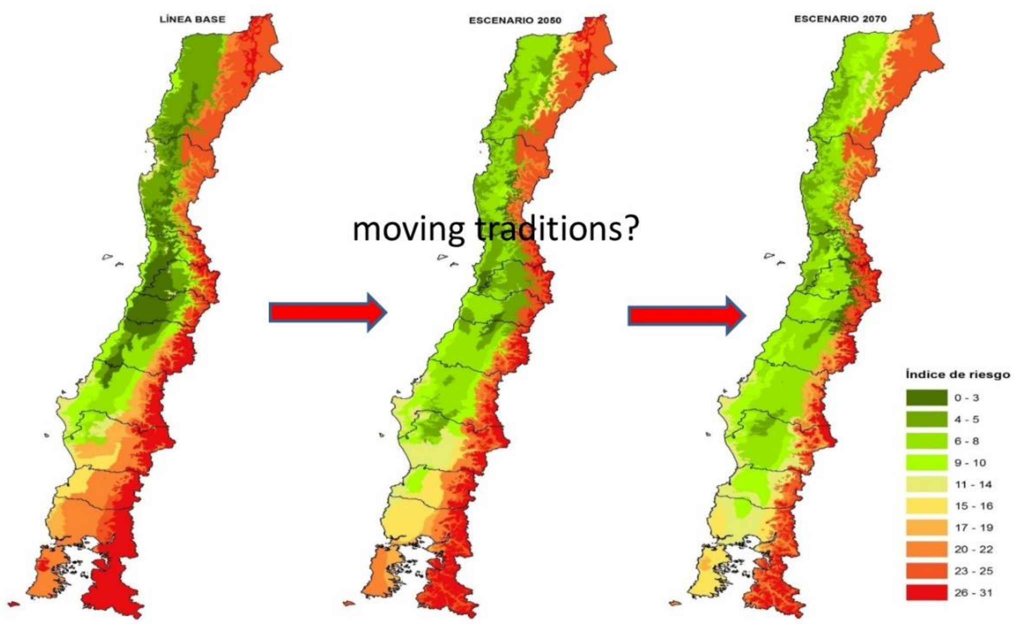

suitability for cherry production
LÍNEA BASE
ESCENARIO 2050
ESCENARIO 2070
Potential improves to the South
Índice de riesgo
2 - 3
4 - 5
6 - 7
8 - 9
10 - 14
15 - 17
18 - 21
22 - 24
25 - 32


suitability for walnut production
LÍNEA BASE
ESCENARIO 2050
ESCENARIO 2070
we will need more technology to
recue walnut
Índice de riesgo
1 - 3
4
5
6
7
8 - 9
10 - 12
13 - 15
16 - 23
24 - 30

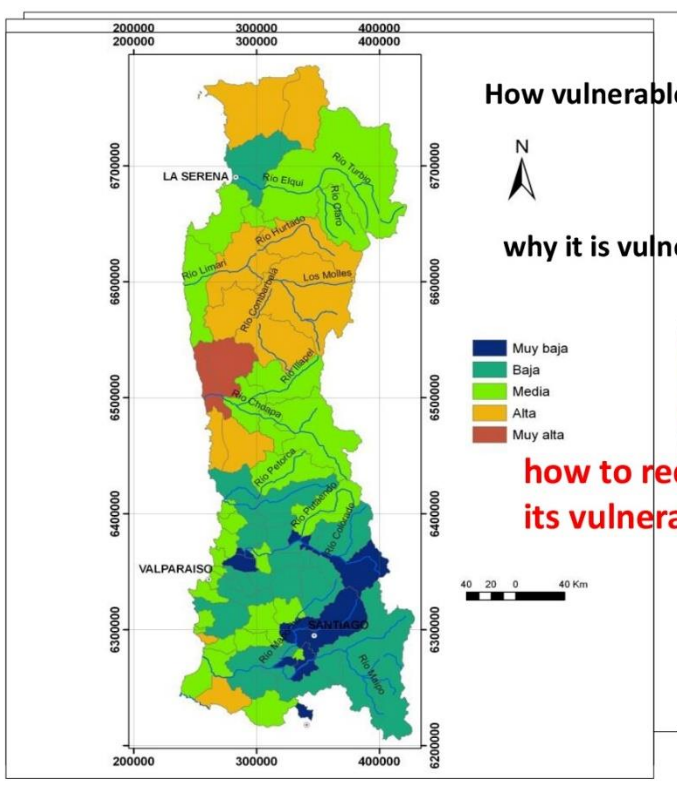
¡ suitability for avocado production



suitability for vine production



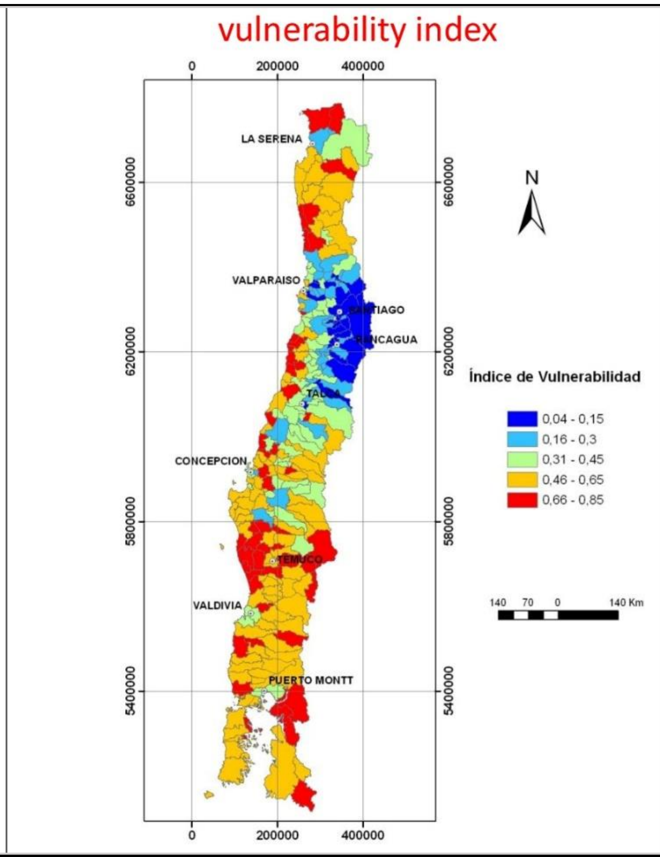
The concept and the meaning of vulnerability

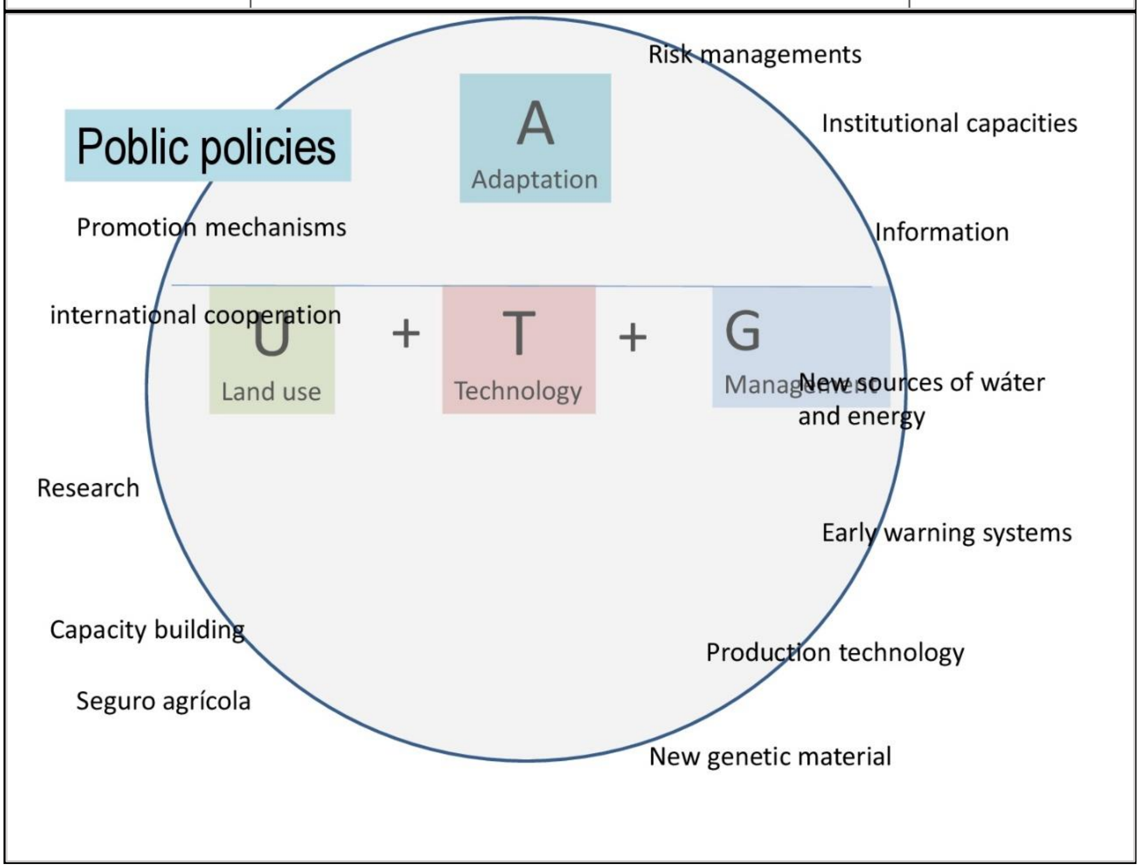


How vulnerable is ?

why it is vulnerable ?

how to reduce its vulnerability?


vulnerability index
LA SERENA
VALPARAISO
CONCEPCION
VALDIVIA
PUERTO MONTT
N
Índice de Vulnerabilidad
0,04 - 0,15
0,16 - 0,3
0,31 - 0,45
0,46 - 0,65
0,66 - 0,85
140 70 0 140 Km


Risk managements
Poblic policies
A
Adaptation
Institutional capacities
Promotion mechanisms
Information
international cooperation
U
Land use
+
T
Technology
+
G
Management
New sources of wáter and energy
Research
Early warning systems
Capacity building
Production technology
Seguro agrícola
New genetic material

Adaptation is a complex process requiring to advance in all its components.

We still have many unanswered questions and tasks wich requires a trasndisciplinary approach going from physical sciences until human sciences.

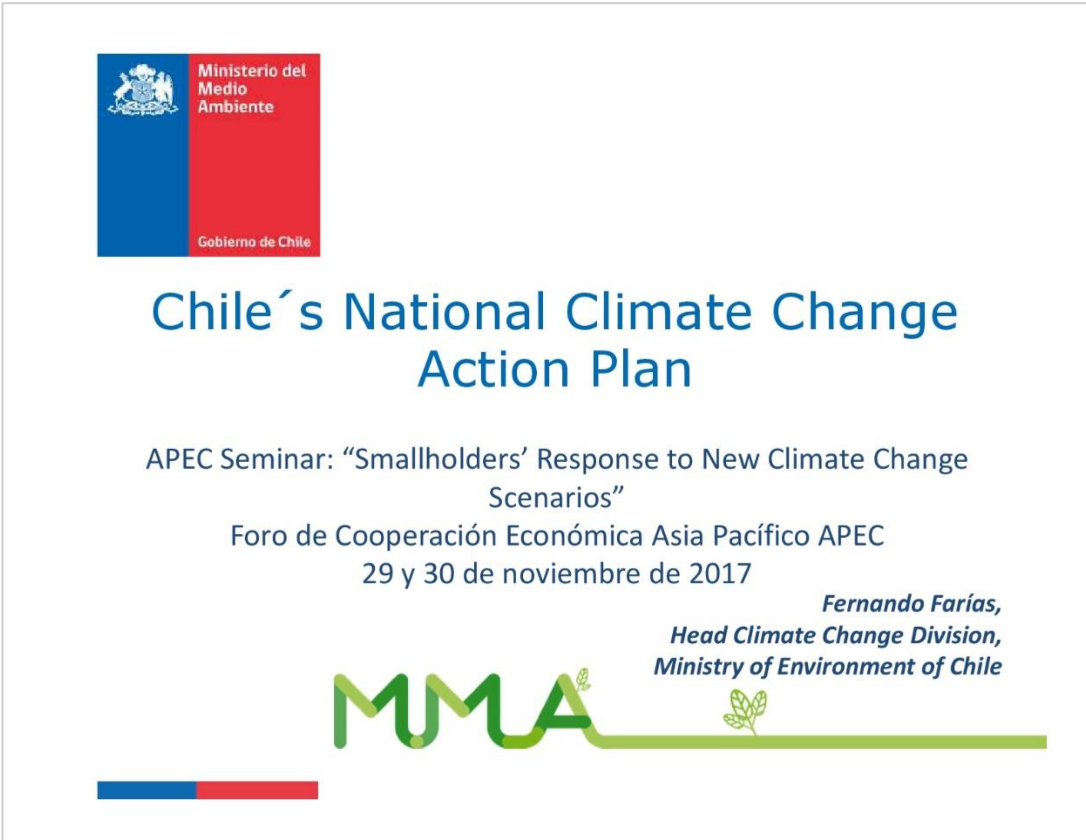
Small farmers are the most vulnerable, they risk to be marginalised if we do not find the way to reduce their vulnerability, imporving the their acces to new technologies, to wáter and knowledge.

Water availability and management will play a key role on the adaptation succes of different countries.

Thank you

Fernando Farías, Climate Change Division, Ministry of Enviroment of Chile, Chile.

Presentation: National Climate Change Action Plan



Contents

- **Climate Change Policy Tools in Chile**
  - National Climate Change Adaptation Plan
  - Sectoral Climate Change Adaptation Plans
  - Chilean NDC for the Paris Agreement
  - National Climate Change Action Plan 2017-2022
  - Chile´s Carbon Tax

- **Climate Change Institutions in Chile**
  - Ministry of Environment
  - Chilean Agency for Sustainability and Climate Change
  - ETICC, CORECCs
  - Green Climate Fund Technical Secretary
  - Presidential Advisory Committee

1. National Climate Change Adaptation Plan

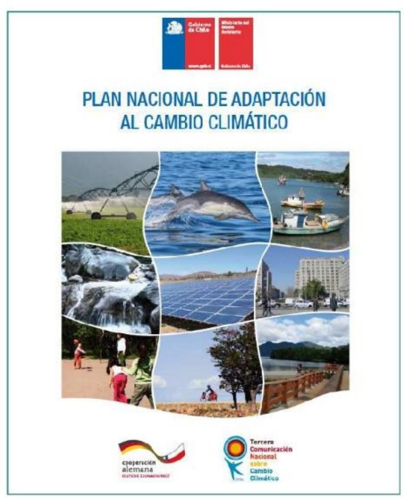
Approved in December 2014 by the Council of Ministries for Sustainability.

The Plan establishes the lines of action for the adaptation in Chile and the operational structure for the elaboration and the implementation of the 9 sectorial adaptation plans:

- Agriculture and Forestry (2013)
- Biodiversity (2014)
- Fisheries and Aquaculture (2015)
- Health (2016)
- Infraestructure (2017)

- Cities (2018)
Energy (2018)

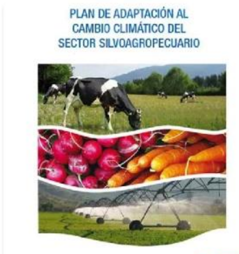
- Water Resources (2018 and beyond)
- Tourism (2018 and beyond)



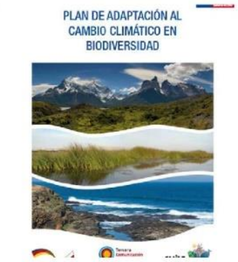
http://portal.mma.gob.cl

2. Sectorial Adaptation Plans to Climate Change

October 2013



July 2014

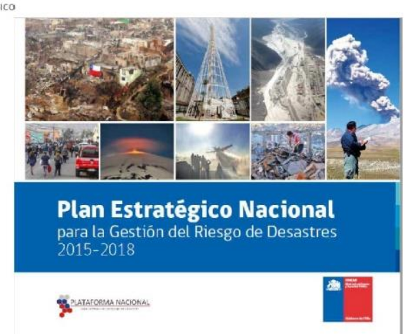


December 2015

December 2016

November 2017

Other Sectorial Public Policies: Forestry, Energy, Disaster Risk



3. Chilean NDC for the Paris Agreement

National Determined Contribution (NDC):

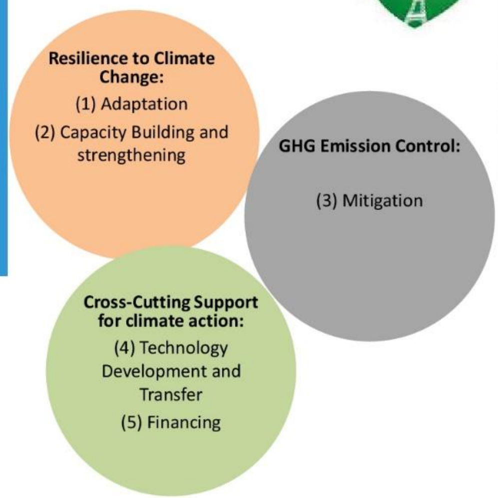
5 Basic Pillars in 3 Axes:

PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

REUNION EN PARIS

Líderes Mundiales Plantean "Punto de Inflexión" en Cumbre del Clima

El presidente de EE.UU., Barack Obama, dijo que su país asume su responsabilidad en el calentamiento global y pidió garantizar un "acuerdo ambicioso".



Chilean mitigation contribution comprehends two components:

1

Goal:
Intensity of Emissions

•To reduce CO_2 emissions per GDP unit by 30% below the 2007 levels by 2030.

•Conditional: 35-45%

2

Goal
Forestry sector

•Sustainable management and recovery 100.000 ha of Forest Land(>Native)

•Reforest 100 .000 ha (>Native)

4. National Climate Change Action Plan 2017-2022 (PANCC)

This Plan is the structural **public policy instrument for climate change,** comprising actions to be implemented by several Ministries and Government Institutions for the next 5 years.

FUERON PRESENTADAS AYER POR EL GOBIERNO

Las 96 medidas para frenar el cambio climático

"Hasta las decisiones personales influyen si uno está contribuyendo **a que el cambio climático se acelere o no**"

Michelle Bachelet, Presidenta de la República

On July the 12th of 2017, the President Michelle Bachelet alongside with 7 State Ministers presented the New PANCC to the Country.

5. Chile Carbon Tax

- In September 2014, Chile passed a General Tax Reform Bill (Ley 20.780) with 3 green taxes.
- Three new taxes were introduced:
  - tax on CO_2 emissions from stationary sources with boilers and turbines (sum over 50MW): US$5/Ton CO2
  - tax on local contaminants also on stationary sources with boilers and turbines (PM, SO_2 and NO_X).
  - tax on the first sale of new cars considering the expected NOx emissions over their lifetime.

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  - tax on the first sale of new cars considering the expected NOx emissions over their lifetime.

II. Insitutional Framework: A new institutional Climate Change framework in Chile to deal with our new responsibilities under the Paris Agreement

- <u>April 2017</u>: President Bachelet signs the enactment of the Law approving the Climate Paris Agreement in Chile

- <u>January 2017</u>: starts operation of the *Agency on Sustainability and Climate Change* to implement climate change projects mostly with the private sector

Agencia de **Sustentabilidad y Cambio Climático**

Ministerio del Medio Ambiente

Gobierno de Chile

Interministerial Technical Team on Climate Change (ETICC)

composed by representatives of the Ministries and Services of the Central Government, with competences in the topic of climate change.

A new institutional Climate Change framework in Chile to deal with our new responsibilities under the Paris Agreement

- <u>March 2016:</u> The Environmental Council of Ministers nominates Vice-Minister of the Ministry of Finance as Chile´s NDA to the Green Climate Fund and creates a Technical Secretariat led by the Ministry of Environment to support the prioritization of projects to be presented by the country to the GCF: so far 2 projects of Chile have received approval to be funded by the GCF

- <u>Since December 2016:</u> Ongoing creation of *Sub-national Climate Change Councils* led by sub-national authorities: CORECC

GREEN CLIMATE FUND


(AL MEDIO) SUBSECRETARIO DE MEDIO AMBIENTE.

Lanzan comité regional de cambio climático

El subsecretario de Medio Ambiente, Marcelo Mena Carrasco, llegó a Iquique para estar presente en el lanzamiento de un comité regional de cambio climático, que tiene como propósito el desarrollo de acciones que mitiguen los

transmitidas por mosquitos.

Este plan de mitigación en Tarapacá aún no tiene una fecha definida y puede demorarse un par de años. "Hay que utilizar la información territorial para saber los cambios de tempe-

Región

O'Higgins trabaja fuerte contra el Cambio Climático

Climate Action at a Subnational Level: CORECC

- A CORECC represents the leadership of sub-national authorities in addressing the challenges of climate change. Convoked by the "Intendente Regional"

Climate Action at a Subnational Level: CORECC

Already implemented in 12 out of the 15 Administrative Regions of the Country

Main function is to promote and facilitate the elaboration and implementation, at the subnational and local level, of policies, plans and actions on climate change, according to regional and local needs and opportunities.

Climate Change Institutionality in Chile
Other recent improvements:

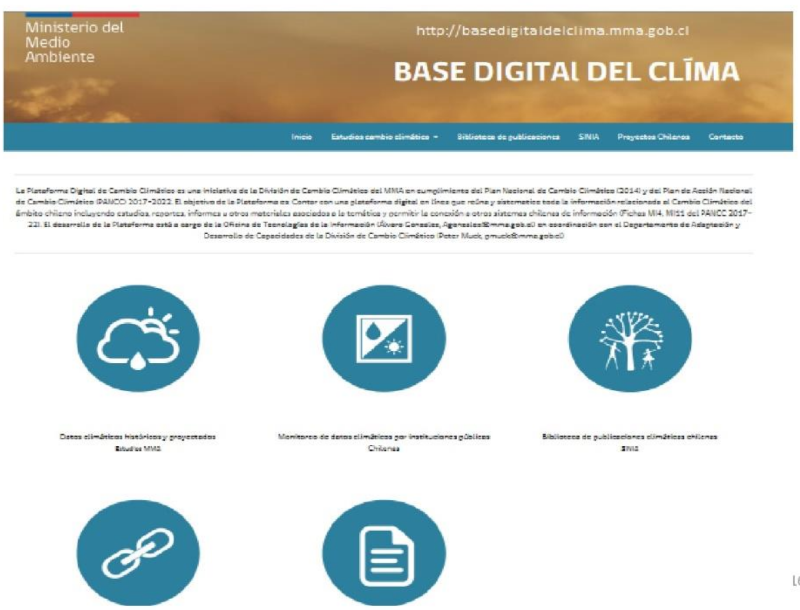
Presidential Advisory Committee on climate change

On November 22nd 2017, the President Michelle Bachelet established the **Permanent Presidential Advisory Committee on Climate Change**
Composed by members of the public sector, private sector, civil society, academia

DIGITAL PLATFORM: BASE DIGITAL DEL CLIMA

Prepared by the Department of Information Technologies and the Department of Adaptation to Climate Change and Capacity Building of MMA

http://basedigitaldelclima.mma.gob.cl



Thank you

Ministerio del Medio Ambiente

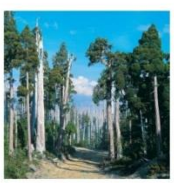
Claudia Carbonell, Office for Studies and Agrarian Policies, Ministry of Agriculture, Chile. Presentation: Climate Change Adaptation Plan for Silvoagropecuary Sector

Index

- General background
- Institutional arrangement and governance for climate change
- Adaptation Plan for agricultural and forestry sector

Highly vulnerable to climate change

Arid areas, semiarid and forest degradation



Fragile mountain ecosystems (Cordilleras de la Costa y de los Andes)

Extensive archipelagos and island territories

Low coastal zones

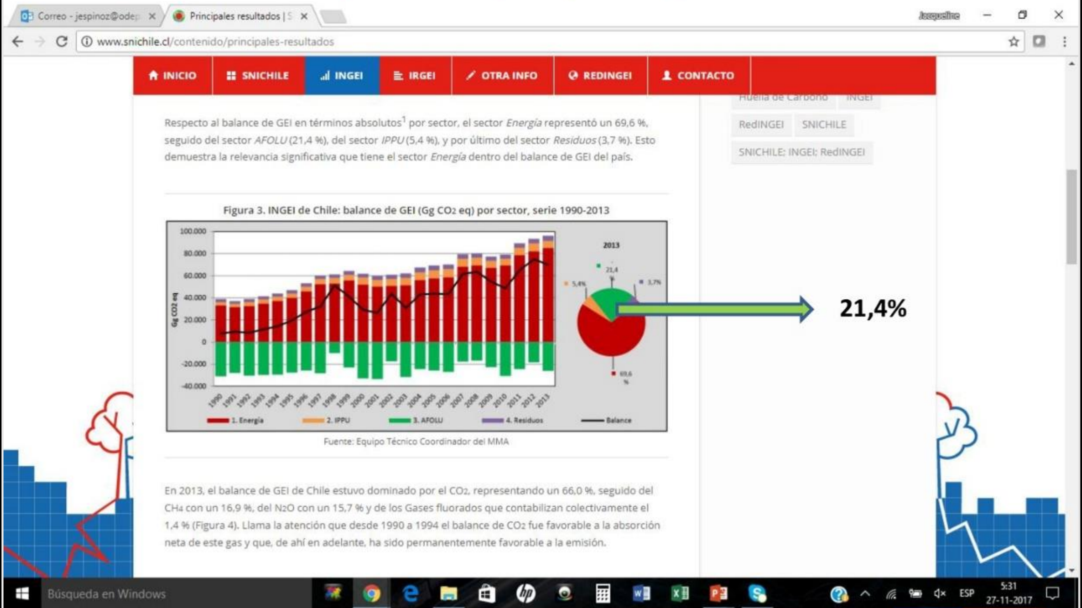
Areas prone to drought and desertification

Susceptibility to natural disasters

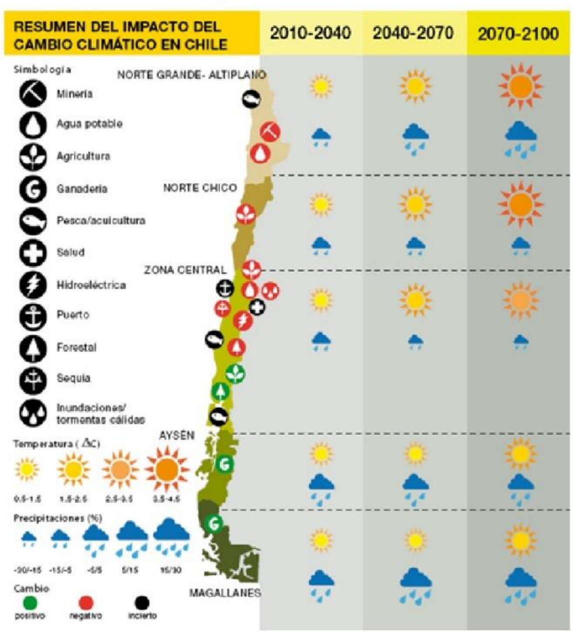
Urban areas with atmospheric pollution

Chile presents 7 out of 9 vulnerability criterias

Chile is responsible only for 0,26% of global emissions



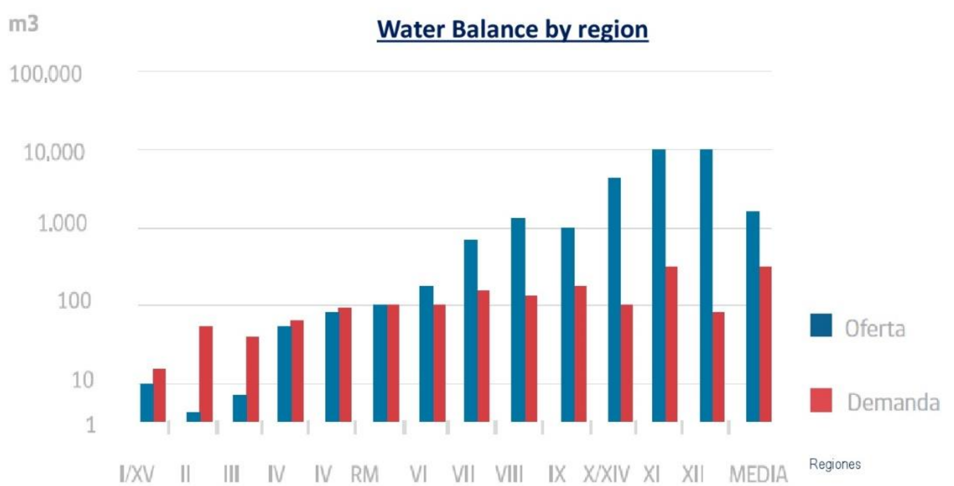
Chile: Impact of climate change



Fuente: CEPAL

The sustained economic growth and social development of the last decades has generated and will continue to generate increasing demands on water resources by different types of users

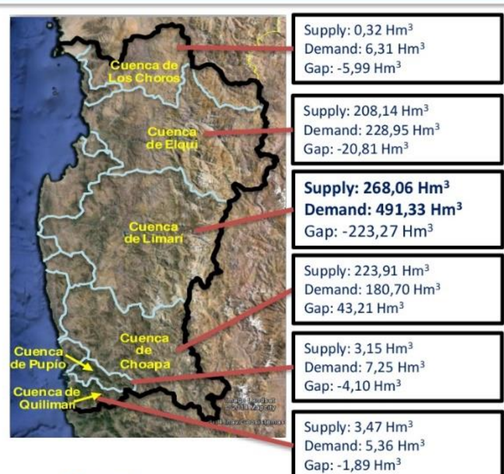
Water Balance by region



Banco Mundial, 2011.

Water is a critical resource

SUPPLY – DEMAND BALANCE: SURFACE WATER (runoff)

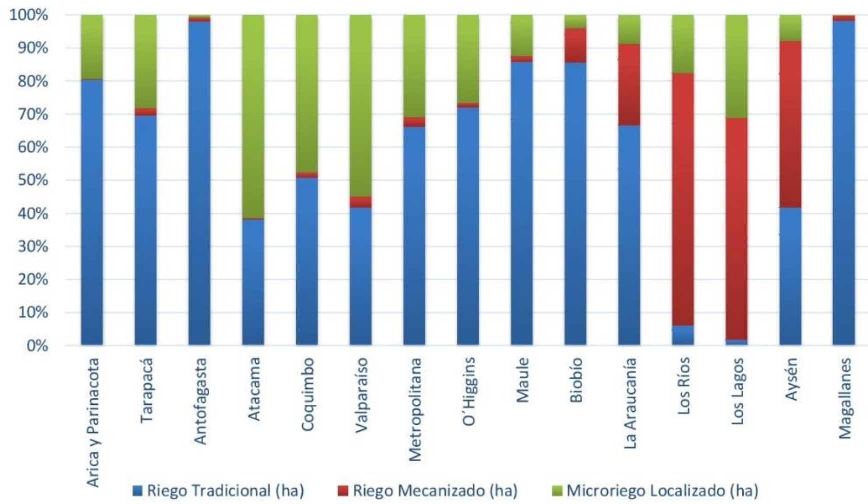


General Balance
- 212,85 Hm^3

Equivalent to 28,4% of Embalse Paloma capacity

Extracciones estimadas, reportadas en Plan Maestro (CONIC BF, 2013)

Irrigation technology by regions (%) (VII Censo, 2007)



Fuente: Odepa a partir de los VI y VII Censos Nacionales Agropecuarios y Forestal, INE-ODEPA, 1997, 2007.

Fruit area evolution by irrigation techonolgy

Catastros frutícolas ODEPA-CIREN

Superficie bajo Tipo de riego	2004		2013		2016	
Tecnificado	95.221	45,23%	211.933	70,60%	235.408	76,10%
Tradicional	115.322	54,77%	88.128	29,40%	74.119	23,90%
Total	210.543	100%	300.061	100,00%	309.527	100,00%

Index

- General background
- Institutional arrangement and governance for climate change
- Adaptation Plan for agricultural and forestry sector

Institutional arrangement and governance for climate change in Chile

- National commitment:
  - Considered in government program
  - Kyoto Protocol and Paris Agreement.
- Coordination among ministries:
  - Ministry of Environment: Technical focal point
  - Ministry of Foreign Affairs: Political focal point
  - Committee of Ministers for Sustainability: Environment, Mining, Foreign Affairs, Energy, Health, Education, Finance and Agriculture
  - Presidential Advisory Commission for Climate Change

Chile: Commitment on Climate Change

- National Strategy
  - International Commitments
    - NAMA's Pre 2020
    - NDC 2020
  - National Action Plan
    - Adaptation National Plan
    - 9 sectorial Adaptation Plans

Ministry of Agriculture: Priorities on CC

- Forestry sector as a major carbon sinks for its natural ability to absorb carbon dioxide and environmental services.
- Access and management of hydric resources.
- Generation of varieties adapted to new agroclimatic conditions
- Generation of prospective information for decision making
- New diseases and plagues
- Capacity building

Ministry of Agricultural: Main initiatives

PLAN SAP	ENCCRV	INVENTARIO GEI SECTOR SAP
 2013 2017/18 **MINAGRI**	 En implementación 2017-2025 **CONAF, INFOR, OTROS SERVICIOS**	 Actualización cada 2 años 2016 **INIA, ODEPA, CONAF, INFOR**
Adaptación	**Mitigación (Adaptación)**	**Mitigación**

Institutional arrangement and governance for Climate Change

- In 2014, the Intraministerial Technical Committee on Climate Change - CTICC was created.
- Participants: FIA, INFOR, ODEPA, CONAF, CNR, INIA, INDAP, SAG, UNEA, CIREN, FUCOA, Deputy secretary and AgroSeguros.
- Objectives: To coordinate strategies and actions of MINAGRI´s institutions on climate change (high authority advice).

Functions of the Intraministerial Technical Committee on Climate Change

- Articulation among ministerial institutions
- Financing for sector projects in CC
- Evaluation and monitoring SAP adaptation plan
- Sectoral inventory coordination
- Capacity building coordination (Training plan)
- Participation in international networks, negotiating platform, and international cooperation

Index

- General background
- Institutional arrangement and governance for climate change
- Adaptation Plan for agricultural and forestry sector

SAP Adaptation Plan

- Commitment within the framework of the National Action Plan on Climate Change 2008-2012.
- It arose from a formal MMA request, in order to accelerate the development of a National Adaptation Plan, built on sectoral plans.
- This proposal was a pioneer with respect to the other sectors of the economy (first Sector Plan)

SAP Adaptation Plan

Medidas 1 y 2

- Strengthen the planning and management of water resources at the national level to optimize the use of water in agriculture (CNR)
- Establish a national program to promote the efficient and sustainable management of water in irrigated agriculture (CNR, INDAP and FIA)

Medida 3

- **Strengthen peasant irrigation program (INDAP)**

Medida 4

- Optimize national system for agroclimatic risk management, GRA (UNEA, Undersecretariat)

Medidas 5 y 6

- Adapt the agricultural insurance instrument to face the CC (INDAP, CORFO and insurance companies)
- Adopt warning systems and integrated control of pests and diseases (SAG, INIA, CIREN)

SAP Adaptation Plan

Medidas 7 y 8

- Support productive investment through the expansion and improvements to the credit system of the forestry and agricultural sector, in order to encourage adaptation to the effects of the CC (State and INDAP)
- Promote the change in the sowing calendar to minimize climate risks (MINAGRI, FUCOA, INDAP)

Medidas 9 y 10

- Encourage the use of culture systems for the reduction of thermal stress (INIA, INDAP, CIREN)
- Support for research and promotion of innovation in water resource management in the forestry and agricultural sector (CNR, FIA, INIA, CIREN, INFOR, INDAP)

Medidas 11 y 12

- Develop breeding programs for agricultural crops vulnerable to CC, using conventional and molecular tools of the latest generation (INIA, INDAP, MINAGRI)
- Develop an ex situ genetic conservation program of forest resources for adaptation to CC (INFOR)

SAP Adaptation Plan

Medidas 13 y 14

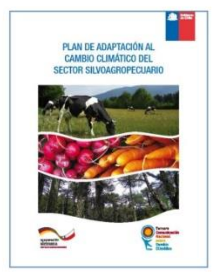
- Strengthen the current mechanisms of the Incentive Systems Program for the Agro-environmental Sustainability of Agricultural Soils (ex SIRSD) (INDAP, SAG)
- Develop systems for permanent monitoring of changes in productivity potentials (PASO, University execution)

Medidas 15 y 16

- Develop a system of indicators of environmental sustainability of agriculture (PASO and Universities)
- Develop new silvicultural methods to face the CC (INFOR, forest owners and CONAF)

Medidas 17 y 18

- Study of water requirements of native and exotic forest species (INFOR, DGA)
- Implementation of rainwater harvesting systems for irrigation and drinking (INDAP, SAG, SERCOTEC, FOSIS)



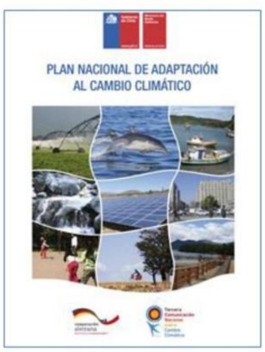
SAP Adaptation Plan

Medidas 19 y 20

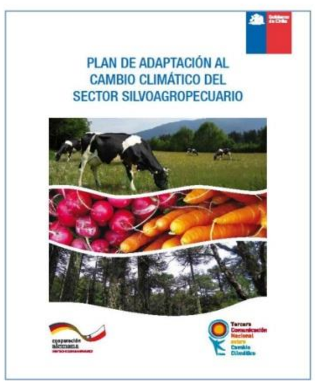
- Design and implementation of a research program on the carbon footprint, in order to incorporate technologies that allow the reduction in the use of water resources in the critical points of the productive chains of agricultural products (INIA, SAG)
- Development of an information system for adaptation to the CC (Services MINAGRI)

Medidas 21

- Development of guidelines to be incorporated in the CC training instances (INDAP, INIA, FUCOA, Universities)



2017-2022



2013-2017

PLAN NACIONAL DE ADAPTACION DEL SECTOR SILVOAGROPECUARIO

Medida 1	a	Medida 21

Acciones y plazos

En implementación

Complementary actions CTICC

- Project "Improvement of Resilience to Climate Change of Small Agriculture in the O'Higgins Region" funded by the Climate Change Adaptation Fund.
- Project of Chile-Mexico Cooperation in Carbon Footprint and Early Alerts: Workshops and internships in Carbon Footprint in Chile and Mexico; and Workshop and internship in Early Alerts in Chile.

Implemented initiatives : progress of CTICC projects

- Capacity building project (EUROCLIMA / GT4 REDPA / CAS): November 2015 Negotiators course, July 2016 Course on GHG inventories

Green Climate Fund: 2 initiatives:

1. Forestry proposal in the framework of the National Strategy on Climate Change and Vegetational Resources (ENCCRV);
2. Agricultural proposal with 3 components (water resources, genetic resources and information). It will be submitted to obtain preparatory funds.

Challenges for the future

- ✓ Ensure enabling conditions for a competitive and sustainable agricultural sector:
  - Improvement of storage, distribution and management of water resources
  - Construction of technical and human capacities for future scenarios: statistics, inventory, indicators, projection platform.
  - Research and innovation in adaptation of genetic resources
  - Prevention and control of pests and diseases by changing scenarios
  - Management of agroclimatic risks

- ✓ Generate conditions for a resilient forest sector, provider of ecosystem services and carbon absortion.

Acciones y desafíos para el futuro

- Portfolio Priority Projects (Green Climate Fund: water, genetic resources, vulnerability platform and ENCCRV)
- Development of regional institutions
- Incorporation of civil society in the design and implementations of initiatives promoted by MINAGRI on climate change

Competitive and inclusive agro-food and forestry sector based on sustainability

Thank you

Xia Ying IAED – Chinese Academy of Agricultural Science (CAAS), China Presentation: Agricultural policy adapt to Climate Change in China: an agriculture development perspective

INSTITUTE OF AGRICULTURAL ECONOMICS
AND DEVELOPMENT, CAAS
IAED

China’s policies for coping with climate change in the perspective of agricultural development environment: Review and Discussion

Dr. Xia Ying

Santiago, Chile , Nov 29,2017

Outline

- 1. Policy background
- 2. Classifications, content and effects of policies
- 3. Policies and effects of coping with climate change in agriculture
- 4. Discussion and prospect expectations

1. Policy background

- In the opening of the International Cooperation Conference on Green Economy and Climate Change in 2010, Premier Li Keqiang said that the problem of climate change is not only an environmental problem but also a problem of development, which has been a common challenge faced by all human beings.
- As an economy that is threatened by climate change, China has always taken its responsibility during the process of globally climate governance.
  - On the one hand, since 1990s Chinese government actively attended the international negotiations about climate change, and promoted the set-up of a fair and reasonable international mechanism of climate change governance together with developing countries.
  - On the other hand, Chinese government has correctly judged the domestic conditions and developing capacity, positively adhered to the Scientific Outlook on Development, insisted on the concept of sustainable development, and put the task of addressing climate change into an extremely important place to guarantee the security of food, ecology and people's lives and property.

2. Classifications, content and effects of policies

2.1 Classifications

2.1.1 Classifications according to policy-making subjects

Since 2007, the State Council published China’s National Plan for Coping with Climate Change, a series of policies to address climate change have been issued and implemented in a top-down order by departments extended from the comprehensive ones to the specialized.

2. Classifications, content and effects of policies

2.1 Classifications

The domestic level. According to National Climate Change Plan (2014-2020) issued by the State Council, National Development and Reform Commission, Ministries and Commissions of the State Council such as Forestry, Water resources, Weather Bureau, Agriculture, Science and Technology, Land and Resources Bureau and Environmental Protection Agency successively formulated specific policies based on their own division and fields.

The local level. According to our domestic plans, strategies and laws, and on account of the reality in each region, the provincial or municipal governments and departments formulated a series of adaptive policies, measures and actions, inserting the adaption of climate change into the specific tasks of social economy and ecological civilization construction.

IAED

2.1.2 Classifications according to the types of industries

The Frist Industry. Agriculture's response to climate change mainly focused on a series of policies and laws initiated by the agricultural service department, including the Ministry of Agriculture, the Ministry of Forestry, the Ministry of Water Resources, the Meteorological Administration and the Oceanic Administration, etc.

The Second Industry. This industry is the key field of energy consumption as well as the important area to slow down the climate change, which formulated a series of industry planning from the aspects of optimizing industrial structure, paying much attention to energy conservation and emission reduction, promoting the advancement of technology and so on.

The Third Industry. The service industry, with low energy consumption in general, has huge potential for facilitating green development. Raising the proportion of service industry in the economy is an important link in promoting the optimization of industries structure, energy conservation and emission reduction, and low carbon development.

2. Classifications, content and effects of policies

2.2 Content

As a non-annex I parties to the Framework Convention on Climate Change and Kyoto Protocol, Chinese government has paid high attention to its international obligations.

- Since 2002, our economy subdivided the field of slowing down climate change, and successively issued Cleaner Production Promotion Law of the PRC, Coal Law of the PRC, Mineral Resources Law of the PRC and Rules for Implementation, Forestry Law of the PRC and Regulation on the Implementation, Provisional Regulations of the PRC on Resource Tax, and Law of the PRC on the Prevention and Control of Atmospheric Pollution

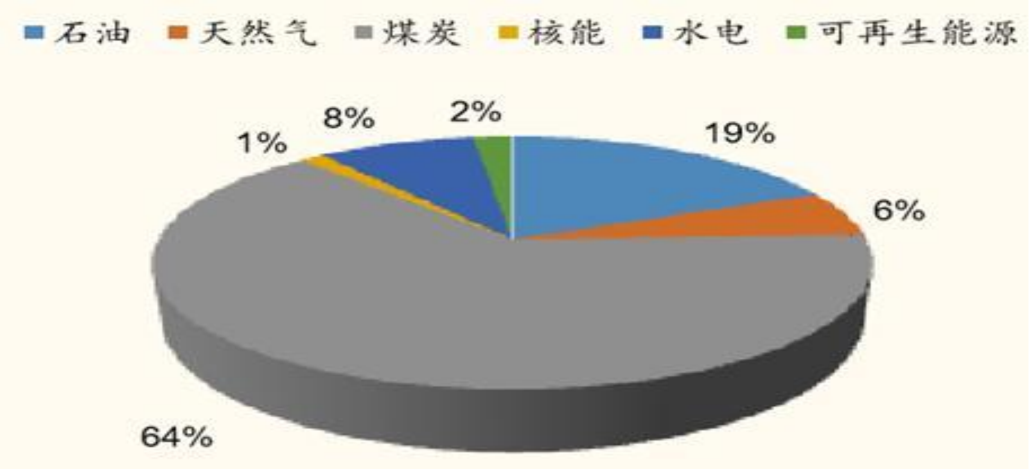
Year	policies and regulations	publisher
2002	--Cleaner Production Promotion Law of the PRC; -- Coal Law of the PRC; -- Mineral Resources Law of the PRC and Rules for Implementation; -- Forestry Law of the PRC and Regulation on the Implementation; -- Provisional Regulations of the PRC on Resource Tax; --Law of the PRC on the Prevention and Control of Atmospheric Pollution	central government
2006	--the Plan for National Economic and Social Development of the PRC	
2007	--China's National Plan for Coping with Climate Change	
2008	--White Paper of the China's Policies and Action on Climate Change	
2013	-- National Strategy of Climate Change Adaptation --National Strategy of Climate Change Adaptation and National Plan for Coping with Climate Change (2014—2020)	
2015	-- "Thirteenth Five-year Plan"	
2017	-- The Belt and Road Ecological and Environmental Cooperation Plan	

2. Classifications, content and effects of policies

2.3 Effects

Now China has got the championship in energy conservation and the utilization of new and renewable resources of energy.

- ❖ The structure of energy utilization began to turn to low-carbon energy system.
  - ➢ In 2015, China's hydropower electricity output was about 1.1 trillion kilowatt hours, accounting for 19.4% of the electric power output and 73.7% of non-fossil energy;



IAED

- to demonstrate and develop green building and low-carbon transportation, and the rate of the sales volume of electric new energy vehicles was 40% of the total sales worldwide; to establish regional carbon emission trading market through pilot projects.

❖In recent year, by implementing supply-side structural reform, the structure between the first, second, and third industries has been further optimized, and the ecological environment has been greatly improved.

- In the last five years, new forest areas in China have been increased over 90 million mu annually;
- 126 million mu of desertified land have been controlled, and land degradation zero growth target is realized, which is typical of the success of global desertification control.
- China’s aquatic ecosystem has been recovered, with the stable improvement of water quality in large rivers and main streams.

❖China contributed the China’s plan to the world through its green development.

In May 2016, the United Nations Environment Program issued the report “Green is gold: The strategy and actions of China's ecological civilization”, which introduced guiding principles, basic concepts and policy measures of the construction of China’s ecological civilization, especially the practice and experience of integrating ecological civilization into national development program.

3. Policies and effects of coping with climate change in agriculture

3.1 Agriculture

The policies of agriculture's response to climate change focused on the improvement of agricultural facilities and equipment conditions and the raise of agricultural science and technology level. A batch of practical technologies and typical patterns were initially formed, and a series of long-acting mechanism for input reduction and comprehensive treatment were gradually established.

- ❖ During the period of "Twelfth Five-year Plan", contribution rate of agricultural scientific and technological progress was up to 56%.
- ❖ The seeds used in agricultural production in China have been basically renovated, and important products like food crops were ultimately fine varieties, with more than 96% coverage of fine crop varieties.
- ❖ The farmland effective irrigated area nationwide was 0.986 billion mu, accounting for more than 52%.

IAED

3.2 Water resources

- Pilot reform of agricultural water rights system.
- The construction of large water conservancy projects was fully speeded up.
- The strictest management system of water resources has taken shape initially.
- The national flood control and drought relief command system, the monitoring system for water resources and the monitoring system of water and soil conservation have taken initial shape.

3.3 Forestry and eco-system

❖ During the period of "Twelfth Five-year Plan", the area of forestation was about 0.45 billion mu nationwide, and the area of forest tending was about 0.6 billion mu, growing 18% and 29% respectively compared with that of the "Eleventh Five-year Plan". Forest coverage increased to 21.66% and forest growing stock was increased to 15.137 billion cubic meter, achieving the goal of the addition of forest growing stock in 2020 ahead of the schedule and becoming the economy with the maximum increase of forest resources at the same period in the globe.

IAED

3.3 Forestry and eco-system

- Total carbon reserves of national forest vegetation increased from 7.811 billion ton in the seventh national forestry inventory (during the year from 2004 to 2008) to 8.427 billion ton in the eighth national forestry inventory.
- Grassland vegetation coverage was up to 54%, 3% higher than that in 2011, and the fulfilled area of banning grazing and delaying grazing was up to 1.53 billion mu in total.
- The area of forage and animal balance was 2.56 billion mu, and the defined area of essential grasslands was 3.53 billion mu.

4. Discussion and Outlooks

As a developing economy, China still faces various problems and challenges in response to climate change.

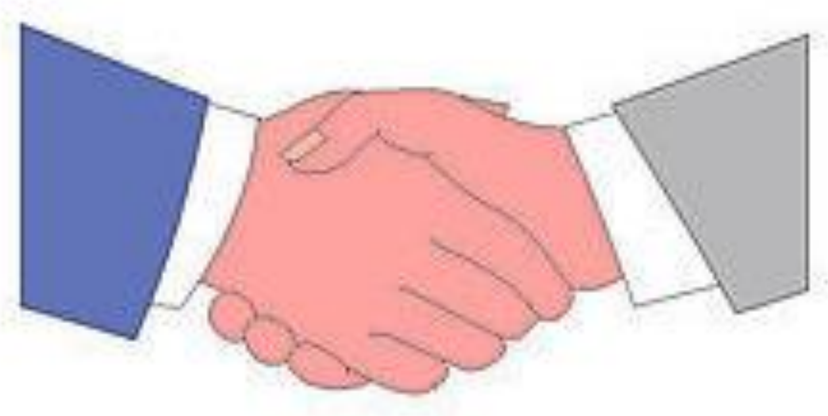
- Development and environmental protection is always a pair of contradictions. The input of environmental protection is not equal to its earnings. The results of protection are easy to share, but the cost is hard to split.

- To more effectively meet the promise that China made in "Intended Nationally Determined Contributions" at the 21st United Nations Climate Conference, it is necessary to codify minds together and think and explore strategies than can be converted to future actions in response to climate change.

4. Discussion and Outlooks

- Firstly, tackling climate change is a long-term and complex task, and the key is the multi-field integrated management with total elements and high efficiency.
- Secondly, strengthen the international negotiations and cooperation.
- Thirdly, enhance relevant basic and applied research.
- Fourthly, promote the legal construction in dealing with climate change.
- Fifthly, massively participate with the whole society.

Thanks for your attention!



xiaying@caas.cn

Zoraida Aranibar, Formulation Department of Piura Government, Peru.

Presentation: Agricultural Policy adapt to Climate Change in north of Peru

AGRICULTURAL POLICY FOR CLIMATE CHANGE ADAPTATION IN NORTHERN PERU (PIURA)

Workshop on Smallholders’ Response to New Climate Scenarios regarding Sustainable Water Use as a Contribution to Food Security

29 November 2017

ECON. ZORAIDA ARANIBAR SEMINARIO

Asia-Pacific
Economic Cooperation

OUTLINE

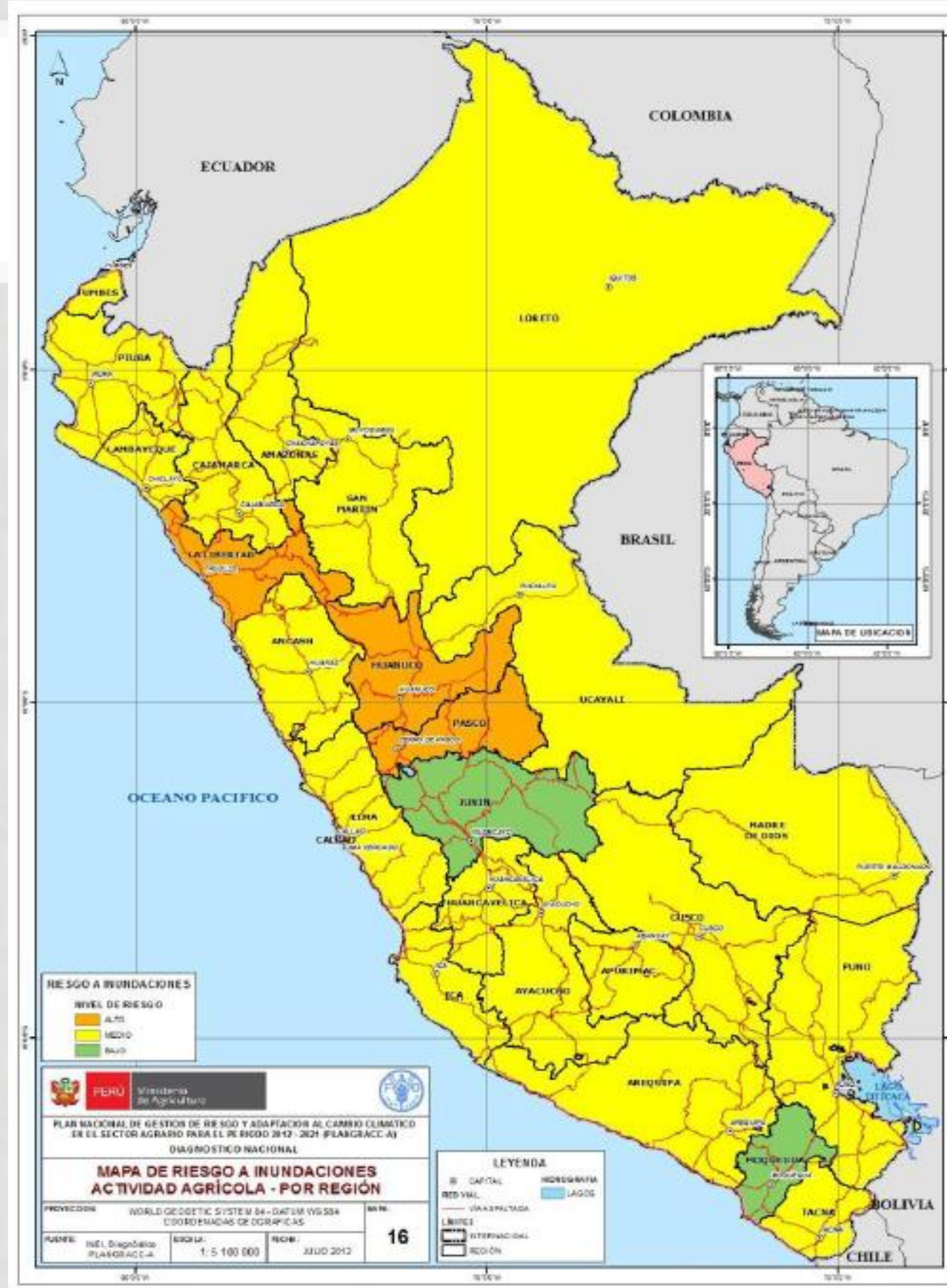
1. PERU IN THE FACE OF CLIMATE CHANGE: GENERAL CONTEXT
2. AGRICULTURE IN NORTHERN PERU IN THE CONTEXT OF CLIMATIC CHANGE
3. AGRICULTURAL POLICY IN THE CONTEXT OF CLIMATE CHANGE
4. CLIMATE CHANGE ADAPTATION IN THE AGRICULTURE SECTOR (CASES)

1. PERU IN THE FACE OF CLIMATE CHANGE: GENERAL CONTEXT

According to the UN Framework Convention on Climate Change (UNFCCC), Peru, highly vulnerable economy to climate change impacts because it has

- Low-lying coastal zones
- Arid and semi-arid zones, areas forest deterioration
- Areas exposed to floods, drought and desertification.
- Vulnerable areas exposed to drought, floods and natural disasters
- Fragile mountain ecosystems.
- High urban air pollution.
- An economy dependent on the production, processing and exports of fossil fuels and associated products of intensive energy or their consumption

FLOOD RISK IN AGRICULTURE

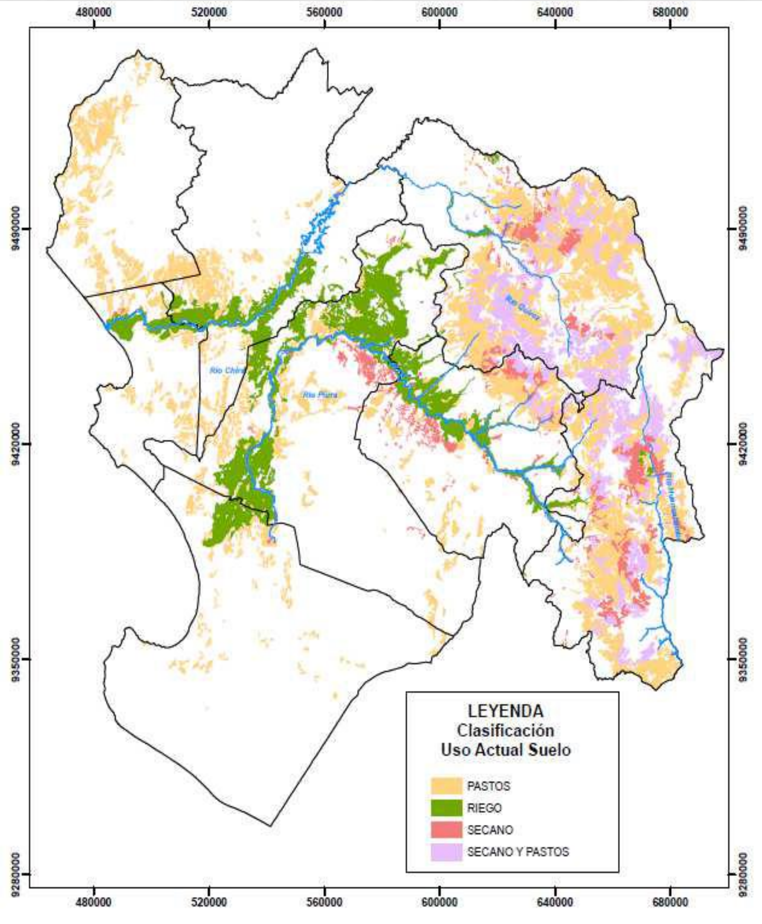


RISK OF FROST IN AGRICULTURE IN DIFFERENT REGIONS

DROUGHT RISK OF AGRICULTURAL ACTIVITY IN DIFFERENT REGIONS

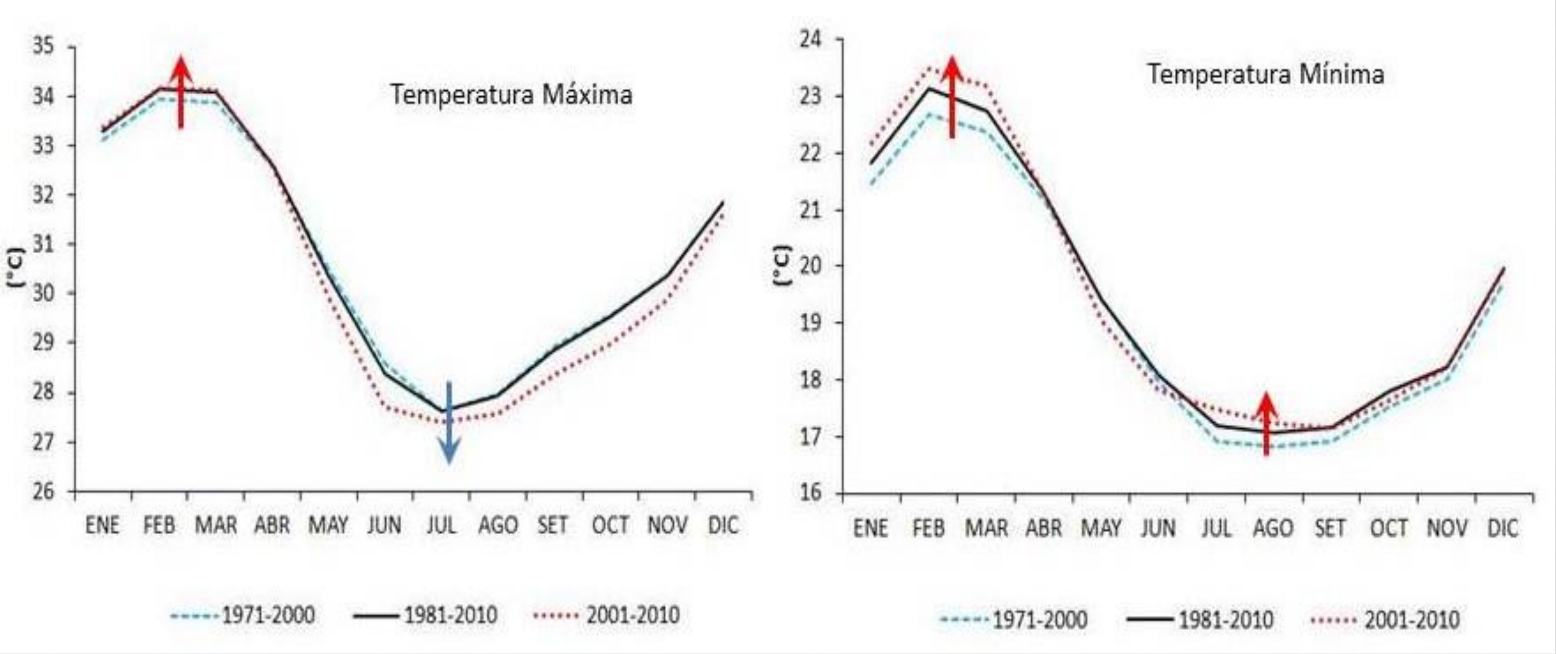
2. AGRICULTURE IN NORTHERN PERU IN THE CONTEXT OF CLIMATIC CHANGE

- In Piura, the activities most affected by climate change are fishing and **agriculture**, making the families that depend on these activities increasingly vulnerable and that they have little access to technology and economic resources



CLIMATE CONTEXT IN THE PIURA REGION - TEMPERATURE

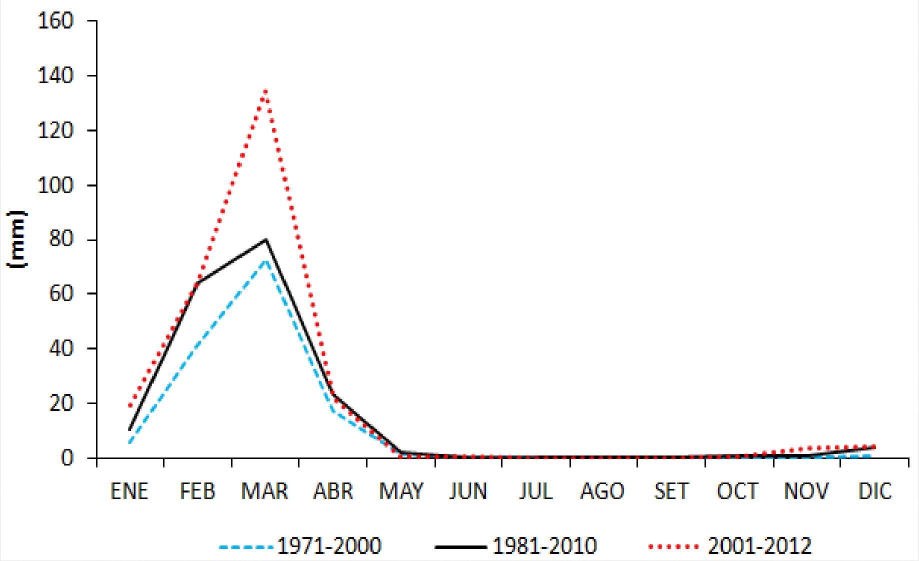
Annual cycle of the maximum and minimum temperature in a representative station - coastal area of the Piura Region

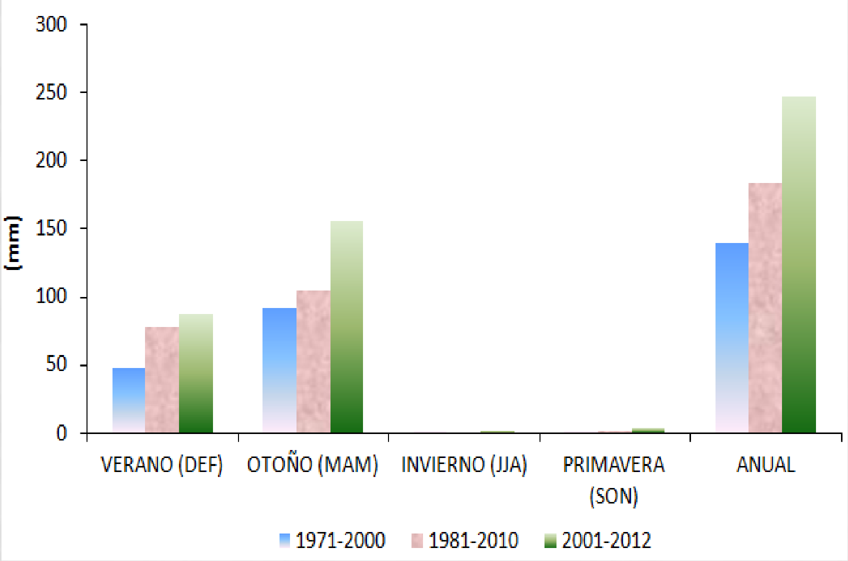


- In the last decade (2001-2010), the maximum temperature in summer increased between 0.2 to 0.3 ° C with respect to the period 1971-2000, while in winter it decreased on average 0.5 ° C with respect to the same period. In general, an interdecadal decrease of the maximum temperature is observed in the autumn, winter and spring seasons.
- In the last decade (2001-2010) the minimum temperature in summer increased between 0.7 to 0.8 ° C, and in winter between 0.3 to 0.5 ° C.

CLIMATE CONTEXT IN THE PIURA REGION - PRECIPITATION

Annual and seasonal rainfall in the coastal area of the Piura Region





- PROCLIM (2005 indicates that rainfall in the Lower Piura and the Middle basin, during the quarters December - January - February (DEF) and March - April - May (MAM), are strongly linked to El Niño events.
- Precipitation shows increases in the coastal region and the northern highlands (MINAM, 2009).
- The frequency of moderate and intense rains has increased in the coast and northern highlands (MINAM, 2009).

IDENTIFICATION OF THE DANGERS FOR AGRICULTURAL ACTIVITY DANGERS

HAZARDS

- Occurrence of warm events
- Frost
- Droughts
- Floods

Associated with anomalies in atmospheric patterns

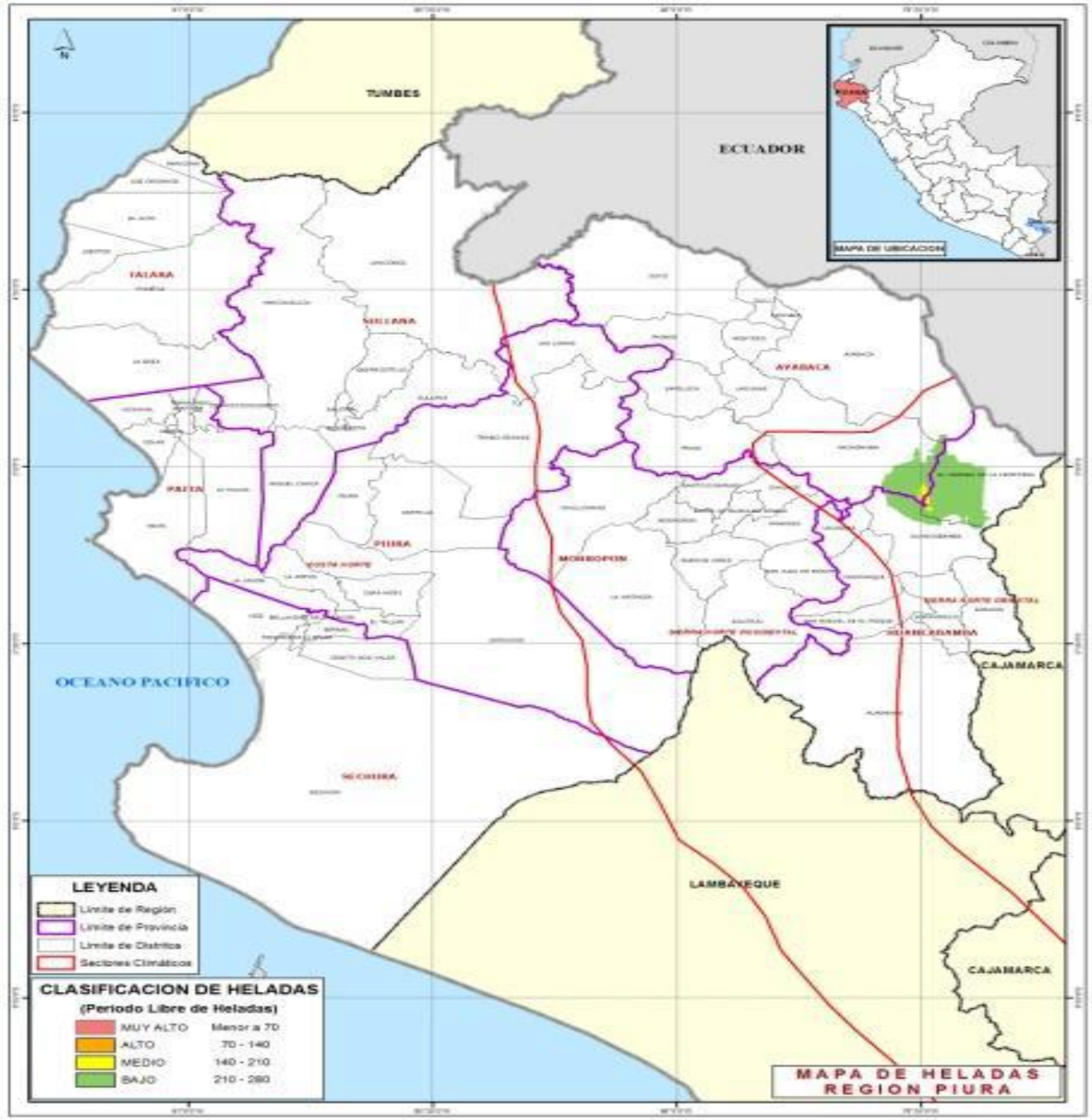
IMPACTS

- Alteration of sowing dates
- Duration of crop cycle
- Yields

AREAS OF POTENTIAL HAZARDS TO AGRICULTURE

1. FROST

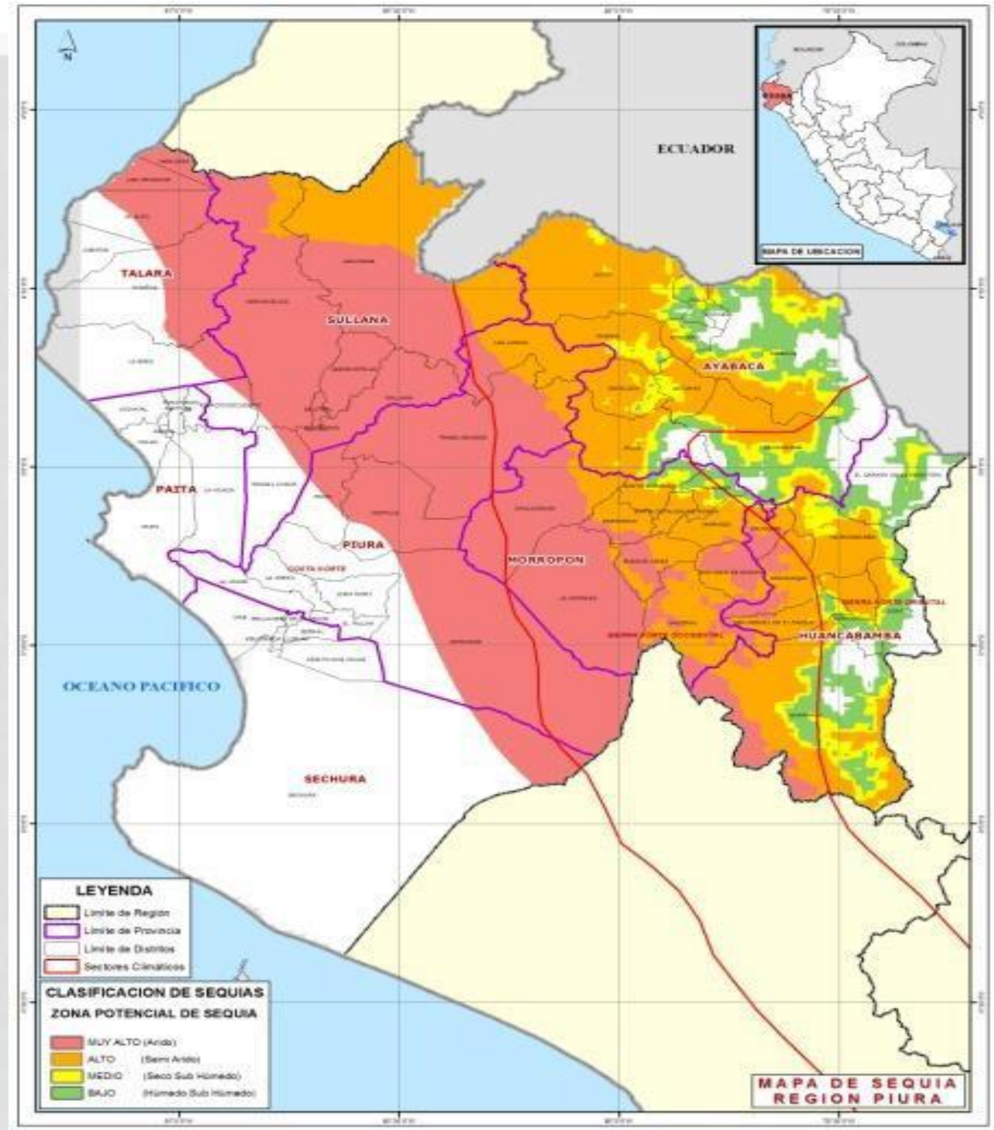
The Andean part of the Piura region experiences absolute minimum temperature anomalies during strong El Niño (1982-1983, 2002-2003) and strong La Niña (1974-1976) (SENAMHI, 2010)



AREAS OF POTENTIAL HAZARDS TO AGRICULTURE

2. DROUGHT

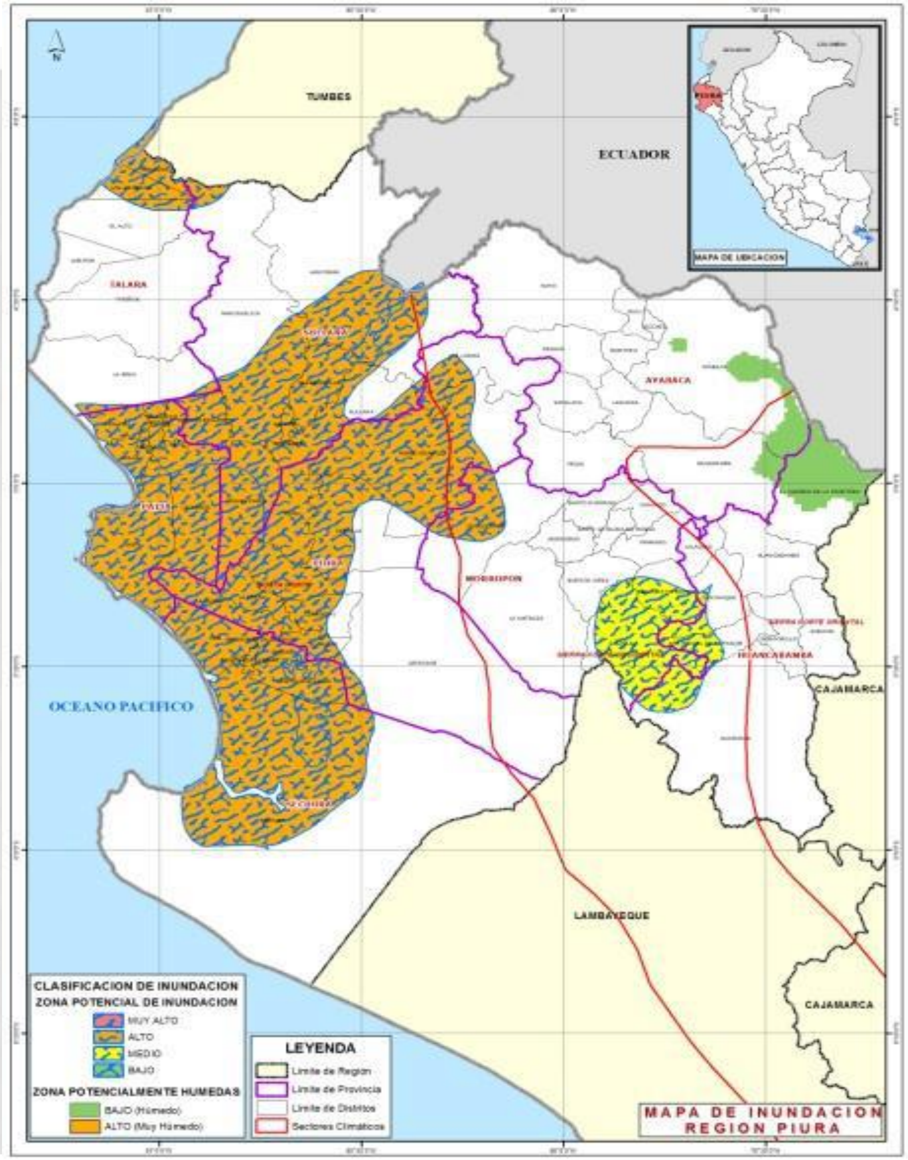
The agricultural droughts take as reference the information of the index of aridity Ip (Precipitation / Evapotranspiration)



AREAS OF POTENTIAL HAZARDS TO AGRICULTURE

3. Floods

Piura is characterized by significant excesses of rain, with different volumes from one intensity to another (strong and moderate “El Niño” phenomenon). These event produce losses of crops and family economies in the valleys of Alto, Medio and Bajo Piura



POTENTIAL HAZARDS TO AGRICULTURE

4. Warm events associated with seawater heating

In the years 2008, 2009 and 2014 during May, June and July persistently the minimum temperature was higher than normal to 2ºC. This variation affected the mango flowering phase due to the fact that it did not reach to accumulate the cold hours.

Ante baja cosecha de mango, productores buscan soluciones

DESDE AYER SE REALIZA EL XXIII CONGRESO DEL MANGO.

Debido a los cambios climáticos, en esta campaña 2014-2015 se prevé una baja importante en la producción del mango peruano. Ante esto los productores esperan compensar sus gastos esperando que la fruta tenga un buen precio en el mercado.

Diferentes productores coincidieron que hay bajas importantes en la producción, pero se mostraron confiados en negociar con los importadores para bajar el precio del transporte y tener un buen precio para el producto. "Por las condiciones del clima vamos a tener una producción menor que la anterior, pero esperamos negociar para compensar esto mejorando el precio del producto" manifestó el productor y exportador de mango Francisco Neyra.

EL CLIMA

Durante la realización del XIII congreso internacional sobre el mango Peruano se expuso sobre las condiciones climáticas que se han presentado en esta campaña. Abraham Levi, presidente de Ambiental Andina explicó a los participantes que el aumento de la temperatura en las costas peruanas han tenido un impacto negativo en los cultivos de mango.

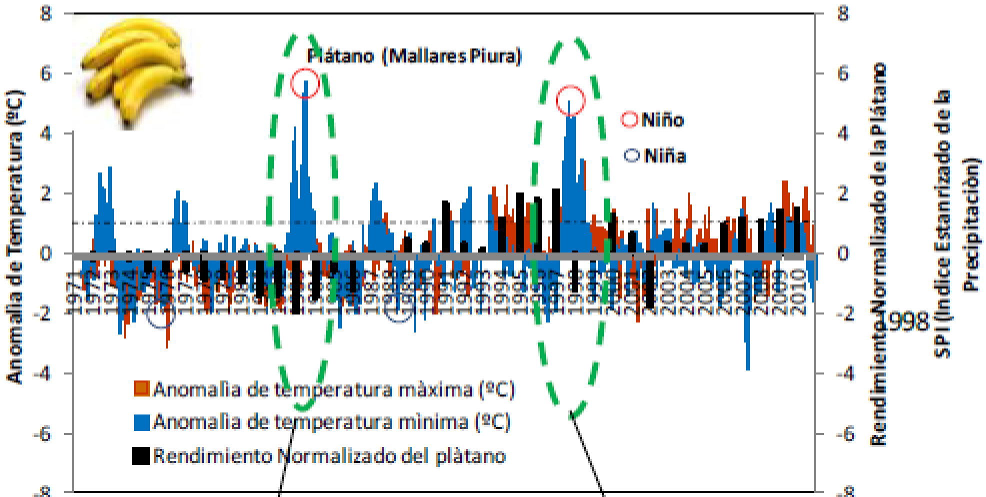
"Las aguas con temperaturas frías permiten una mejor afloración de las frutas, mientras que las aguas calientes menos afloración" explicó el experto.

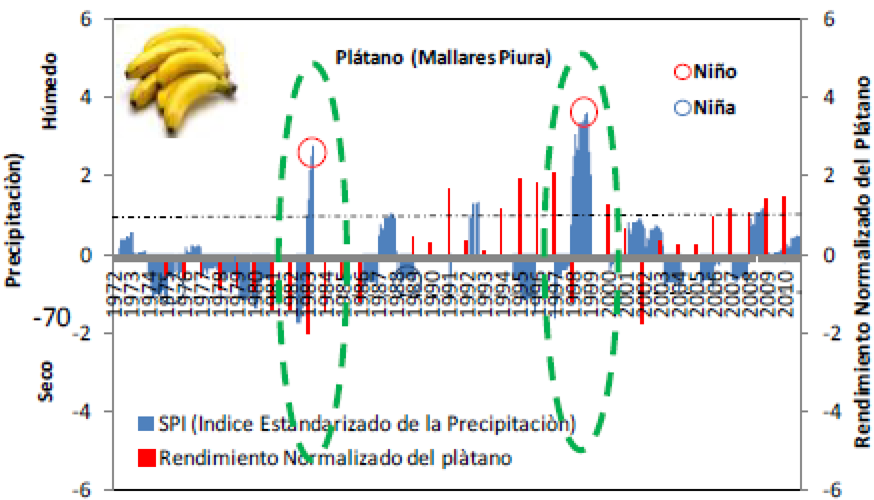
Por su parte el presidente de la Asociación Peruana de Productores y Exportadores de mago (APEM), Joaquín Balarezo destacó la importancia de la asociación que actualmente en el mercado representa el 50% del total de exportación de mango. □

RISK ANALYSIS OF AGRICULTURAL ACTIVITY IN THE PIURA REGION

Frost	Drought	Floods
• Of 56 districts studied for the Piura Region, only 3 districts are at risk of frost in agricultural activity	• Of 56 districts studied for the Piura Region 40 districts are at risk from drought	• Of 56 districts studied for the Piura Region, 34 districts are at risk of flooding

IMPACT OF THE TEMPERATURE ANOMALIES IN THE BANANO

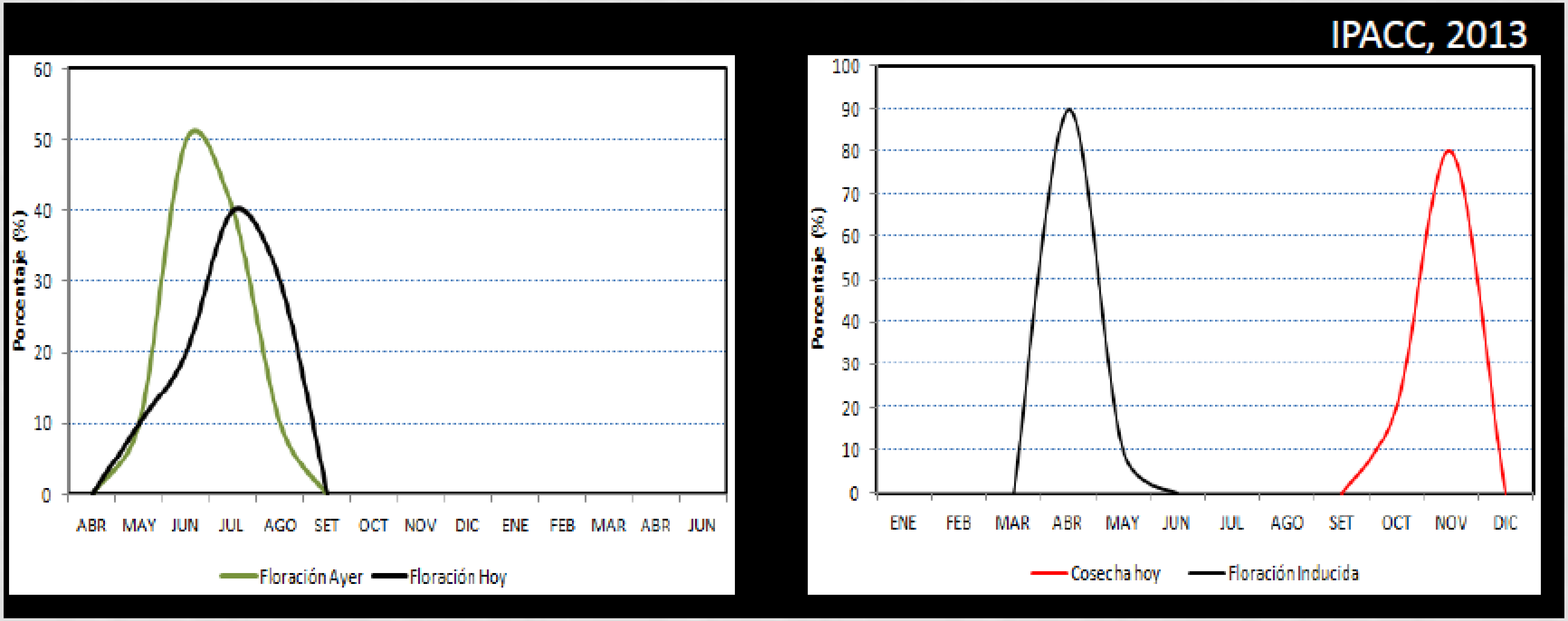




1982= -25%
1983= -63%

1998= -70%

LOCAL PERCEPTION OF RISK - CULTIVATION OF MANGO



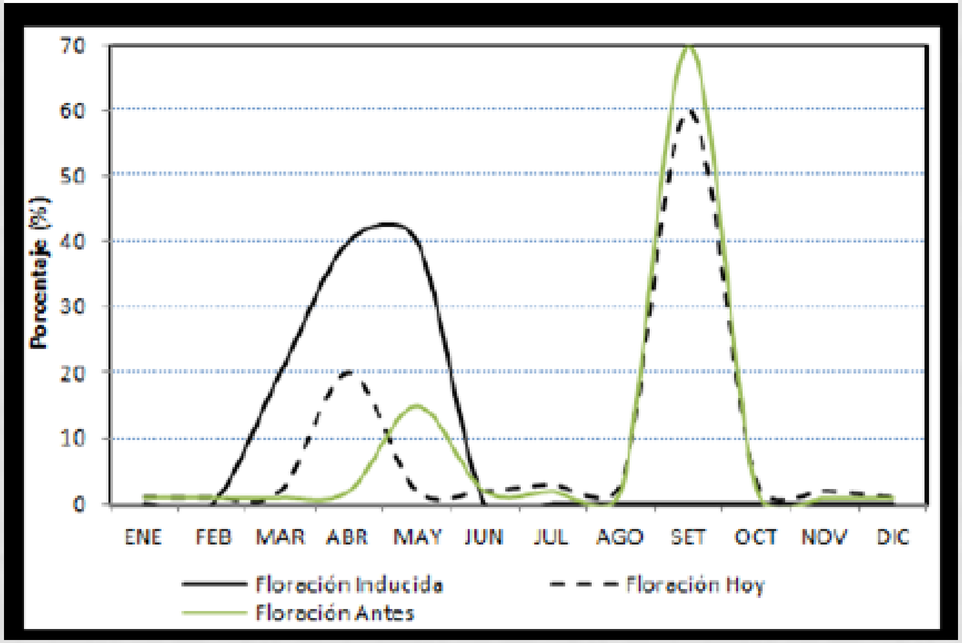
Previously the mango had its maximum flowering in June, and today the peak of flowering is observed in July, delaying the beginning of harvest at the end of November ". In the valley, the flowering of the mango crop (Edwar and Haden varieties) is induced in March to have a maximum of flowering in April (90%) and in this way to advance the harvest for the months of October and November.

LOCAL PERCEPTION OF RISK - LEMON CULTIVATION

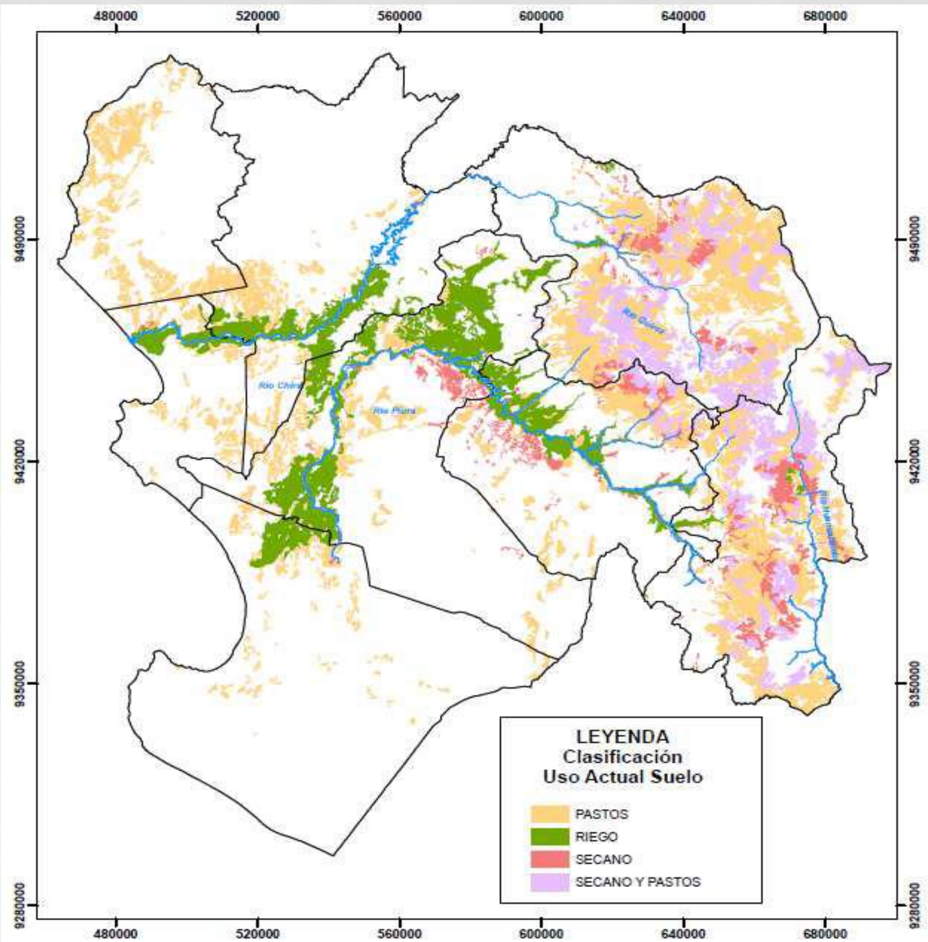
Lemon production shows changes in the peaks of flowering.

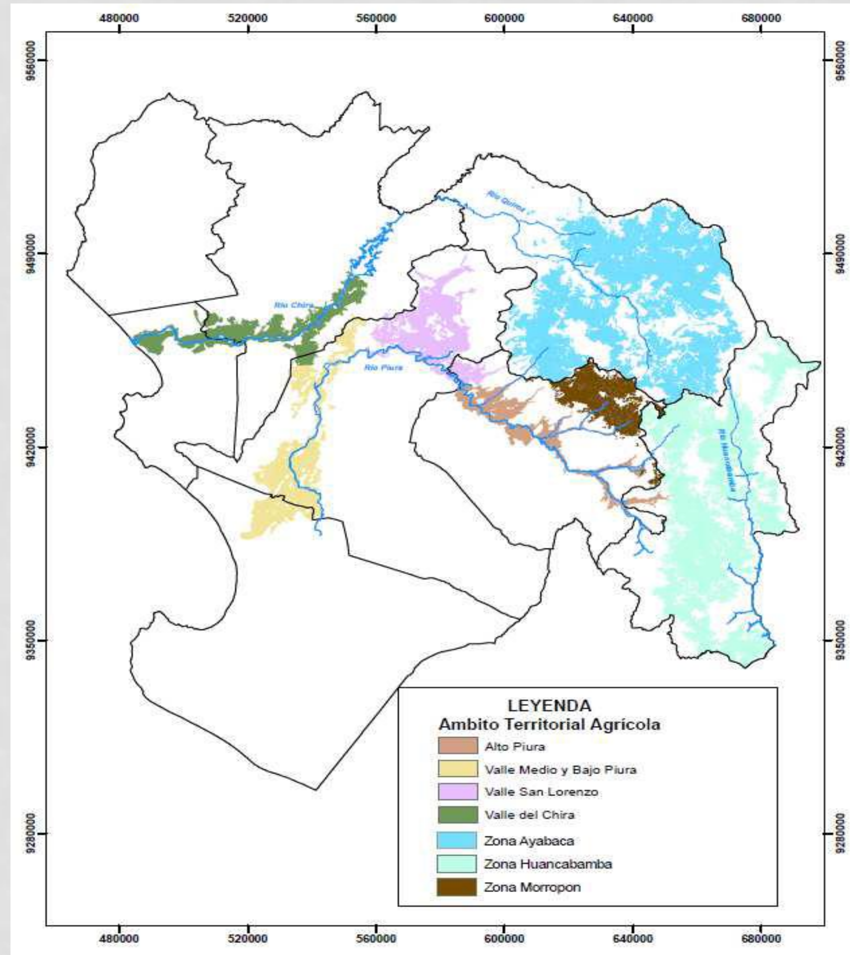
In the past, the highest flowering reached 70% in September, while today it has been reduced to 60%.. The traditional production cycle (today) generates more production in a period of low prices (December to January), which is why some farmers induce flowering in the month of April, to obtain production from September.

This means lower production but higher price in the market.



PHYSICAL FACTORS - TERRITORIAL CHARACTERISTICS

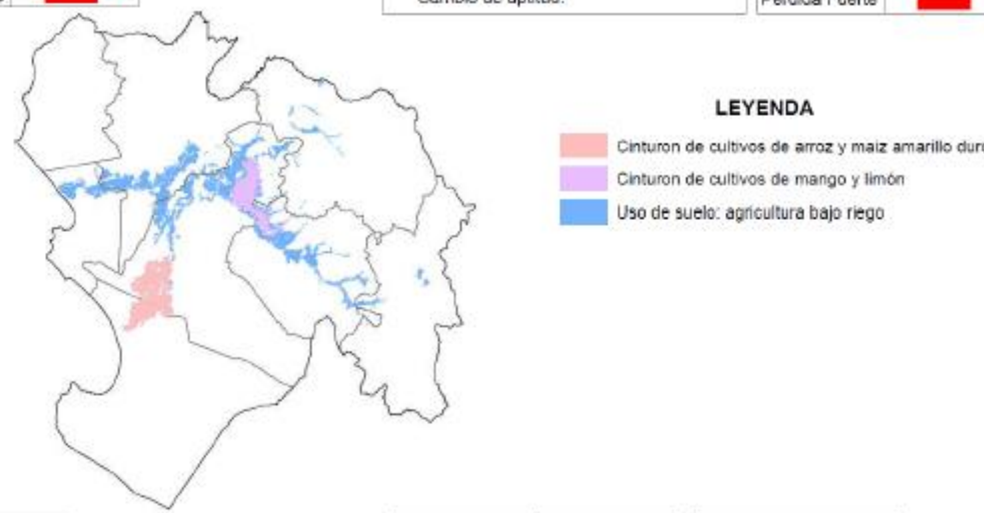




CHANGES IN AGRICULTURAL PERFORMANCE UNDER THE 2030 SCENARIO

Cultivo	Mango	Valle San Lorenzo
Rendimiento máximo periodo 2001-2014:	31941.9	Kg/ha
Rendimiento promedio 2010-2014:	13093.8	Kg/ha
Rendimiento promedio año 2030:	5422.9	Kg/ha
Aptitud climatica actual:	41.0	%
Aptitud climatica futura:	17.0	%
Cambio de aptitud:	Pérdida Fuerte	

Cultivo	Limón	Valle San Lorenzo
Rendimiento máximo periodo 2001-2014:	15466.4	Kg/ha
Rendimiento promedio 2010-2014:	8385.1	Kg/ha
Rendimiento promedio año 2030:	6466.3	Kg/ha
Aptitud climatica actual:	54.2	%
Aptitud climatica futura:	41.8	%
Cambio de aptitud:	Pérdida Fuerte	



Cultivo	Maiz Amarillo Duro	Valle Medio y Bajo Piura
Rendimiento potencial:	8000.0	Kg/ha
Rendimiento promedio 2010-2014:	4715.6	Kg/ha
Rendimiento promedio año 2030:	7158.0	Kg/ha
Aptitud climatica actual:	58.9	%
Aptitud climatica futura:	89.5	%
Cambio de aptitud:	Más Apto	

Cultivo	Arroz	Valle Medio y Bajo Piura
Rendimiento potencial:	1200.0	Kg/ha
Rendimiento promedio 2010-2014:	9315.6	Kg/ha
Rendimiento promedio año 2030:	11516.2	Kg/ha
Aptitud climatica actual:	77.6	%
Aptitud climatica futura:	96.0	%
Cambio de aptitud:	Más Apto	

3. AGRICULTURAL POLICY IN THE CONTEXT OF CLIMATE CHANGE

GOBIERNO REGIONAL PIURA
CONSEJO REGIONAL

ORDENANZA REGIONAL QUE APRUEBA LA ESTRATEGIA REGIONAL DE CAMBIO CLIMÁTICO EN PIURA

ORDENANZA REGIONAL Nº 224 - 2011/GRP-CR

El Consejo Regional del Gobierno Regional Piura;

POR CUANTO:
El Consejo Regional del Gobierno Regional de Piura, de conformidad con lo previsto en la Constitución Política del Perú de 1993, modificada por la Ley de Reforma Constitucional del Capítulo XIV, del Título IV, sobre Descentralización – Ley Nº 27680, Ley de Bases de la Descentralización – Ley Nº 27783, Ley Orgánica de Gobiernos Regionales – Ley Nº 27867 y su modificatoria, Ley Nº 27902 y demás Normas Complementarias;

Piura Región — Estrategia Regional de Cambio Climático

GOBIERNO REGIONAL PIURA

GERENCIA REGIONAL DE RECURSOS NATURALES Y GESTION DEL MEDIO AMBIENTE

ESTRATEGIA REGIONAL DE CAMBIO CLIMATICO

Noviembre - 2011

PODER EJECUTIVO

AGRICULTURA

Aprueban el "Plan Nacional de Gestión de Riesgo y Adaptación al Cambio Climático en el Sector Agrario, período 2012 - 2021 (PLANGRACC-A)"

RESOLUCIÓN MINISTERIAL
Nº 0265-2012-AG

Lima, 6 de agosto de 2012

REGIONAL CLIMATE CHANGE ORDINANCE

- The Regional Ordinance entrusts all the technical groups of the Piura Regional Government with the immediate implementation and direct execution of the activities, initiatives and normative adjustments to execute the Regional Climate Change Strategy
- Its main objective is to contribute to the reduction of greenhouse gases, and therefore mitigate the harmful effects caused by these in Piura, assigning the necessary economic resources according to budget availability.

REGIONAL CLIMATE CHANGE STRATEGY (ERCC) - PIURA

OBJECTIVE

The general objective of the ERCC is to reduce the adverse impacts of CC, through the promotion of a culture of prevention and of the joint responsibility of GRP, GL and civil society in the development and implementation of adaptation and mitigation measures.

CHALLENGES

- The reduction of vulnerability and adaptation to Climate Change;
- The management of water resources;
- The mitigation potential that regional Conservation Areas can exert. and the National Protected Areas

STRATEGIC OBJECTIVES OF THE ERCC

STRATEGIC OBJECTIVES	GOALS	ACTIONS
SO 1: Regional actors identify the vulnerabilities of Piura from CC and propose and adapt measures to be implemented.	PDRC 2021 of Piura incorporates guidelines and measures aimed at reducing vulnerability and to apply effective and sustainable measures of adaptation to the adverse effects of CC.	Training for professionals and public officials in the design of instruments and tools for planning and public programming considering CC at the level of tregiont, province or district.

STRATEGIC OBJECTIVES OF THE ERCC

SO 2: The Regional Council of Water Resources of the Chira-Piura Basin promotes the integrated management of this resource under an ecosystem approach and in a CC context.

→

CRHCCHP based on studies have implemented recovery proposals for the water producing ecosystems: fog and cloud forests in the Chira and Piura basins.

→

1. Promote the application of irrigation efficiency techniques in agricultural activity to reduce land degradation and reduce vulnerability to drought.
2. Conserve and recover the water producing ecosystems in the headwaters of the basin: cloud and fog forests
3. Design and execute proposals aimed at reducing land degradation, and the effects of drought and floods caused by CC.

CONTEMPORARY AGRICULTURAL PRACTICES FOR ADAPTATION TO CLIMATE CHANGE (ACC) AND DISASTER RISK MANAGEMENT (DRG) IN THE PIURA REGION

CLIMATE HAZARD	CONTEMPORARY PRACTICES		
	Goal	Name	Description
Drought	Impact reaction	Organic fertilization	Manure and guano utilization
Drought	Impact reaction	Silos to store food	Food security
Drought	Impact adaptation	Forestation and reforestation	forestry and shrub plantation for commercial or conservation purposes
Drought and frost	Impact adaptation	Agroforestry	Forest plantation associated with crops and pastures
Floods	Impact reaction	Bags with soil	Put bags o the riverbanks
Floods		Enrocado	put stones on the riverbanks

The PLANGRACC recommends evaluating the expenditure and public investment made by the GRP on issues of ACC and GDR to the agricultural sector, in order to propose projects on ACC and GRD. For this, it is necessary to continue raising awareness of DRM and CCA issues, given the importance of the issue at all levels, particularly with regional and local authorities.

4. CLIMATE CHANGE ADAPTATION IN THE AGRICULTURE SECTOR (CASES)

CASE 1: The incorporation of the GdR in Agricultural Project in the San Lorenzo Valley in a context of climate change

Risk analysis

Hazard: Floods
- ✓ Greater occurrence and intensity of FEN and greater occurrence of heavy rains.

Exposure:
- ✓ Irrigation system and farmland.

Vulnerability:
- ✓ System: earthen canals, without drainage works.
- ✓ Farmland without drainage.
- ✓ Emergency contingency fund is insufficient.

Risks: probable damages and losses

Infrastructure damage and interruption of water service for irrigation.

Risks associated with CC

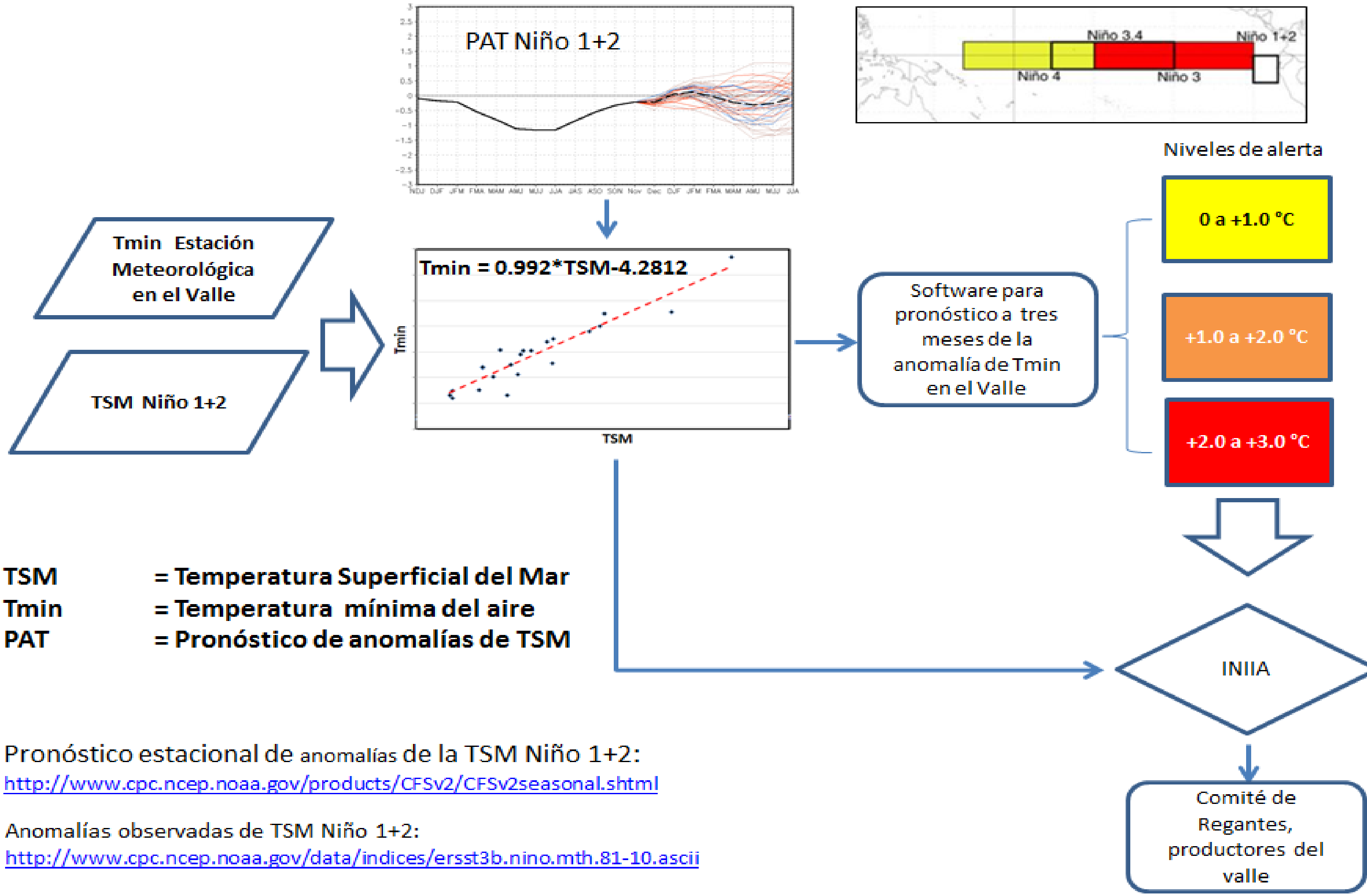
Average temperature increase → Higher ET → Increase in water demand (0.63%, 10 years)

Minimum temperature increase (warmer winters)

Sparse weather information and low technical knowledge on floral induction and sprout maturation

Decreased flowering and production in the stage of fruit growth

ADAPTATION MEASURES FOR AGRICULTURAL PROJECT - AGROMETEOROLOGICAL EARLY WARNING SYSTEM (SAN LORENZO VALLEY)



TSM = **Temperatura Superficial del Mar**
Tmin = **Temperatura mínima del aire**
PAT = **Pronóstico de anomalías de TSM**

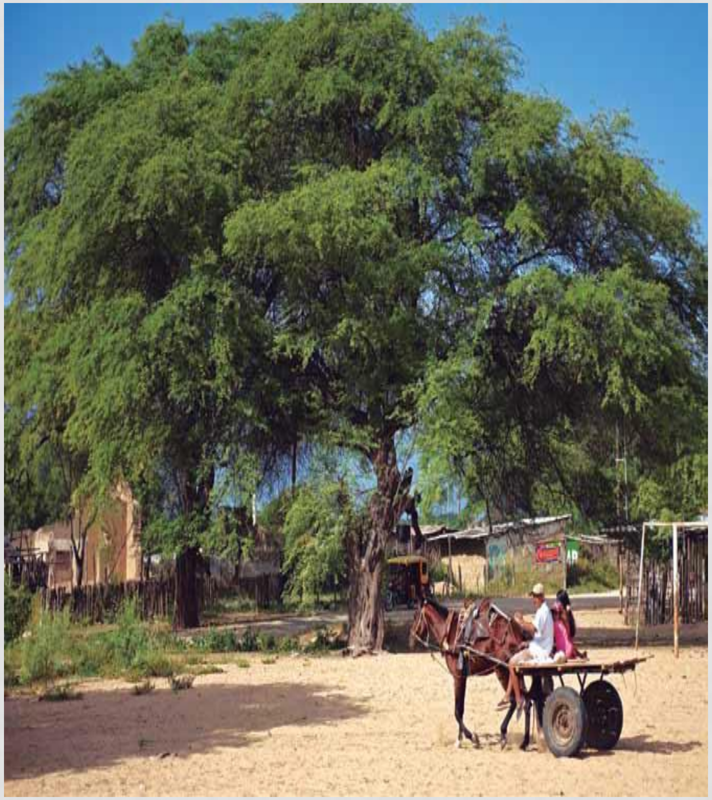
Pronóstico estacional de anomalías de la TSM Niño 1+2:
http://www.cpc.ncep.noaa.gov/products/CFSv2/CFSv2seasonal.shtml

Anomalías observadas de TSM Niño 1+2:
http://www.cpc.ncep.noaa.gov/data/indices/ersst3b.nino.mth.81-10.ascii

LEVELS OF ALERT FOR THE CULTIVATION OF MANGO DURING THE FLOWERING STAGE – DATE OF DECISION MAKING: MAY.

Anomalías Tmin	Nivel de Alerta	Impacto	Medidas Adaptación
0.0 a +1.0 ℃		Rango óptimo de Tmin para la mayoría de las variedades en la floración: 16 a 18 ℃. Tmin > 18 ℃ durante esta fase (junio – agosto) reduce la floración y afecta finalmente el rendimiento	Manejo de riego para controlar y extender el crecimiento vegetativo
+1.0 a +2.0 ℃			Inducción floral y manejo de riego dependiendo de la tendencia e intensidad de anomalías
+2.0 a +3.0			

CASE 2: ADAPTATION TO CLIMATE CHANGE FOR AGRARIAN COMPETITIVENESS: ALGARROBA



i. Awareness of the rural population that uses the dry forest

ii. Biologic control

iii. Control with biocidal plants

iv. Cultural control

PROJECTS OF ECOSYSTEM SERVICES OF HYDRAULIC REGULATION

- The Regional Directorate of Piura Agriculture generated 04 water regulation projects in the headwaters of Cuenca in the Piura mountains to control soil erosion and land degradation that occurs in times of intense rainfall with activities such as:
  - Infiltration trenches
  - Afforestation and reforestation
  - Agroforestry activities

THANK YOU!

ECON. ZORAIDA ARANIBAR SEMINARIO

Antonio Yaksic, Information, Monitoring and Prevention for Risk Management Department, Ministry of Agriculture of Chile Presentation: Risk management in the agriculture.

INTEGRATED RISK MANAGEMENT IN AGRICULTURE

Information, Monitoring and Prevention

APEC SEMINAR: "Small holders response to new climate change scenarios". Santiago- Chile, November 2017

Antonio Yaksic S, Chef Manager, Sub Departament of Information, Monitoring and Prevention for Integrated Risk Management (IMP-IRM)

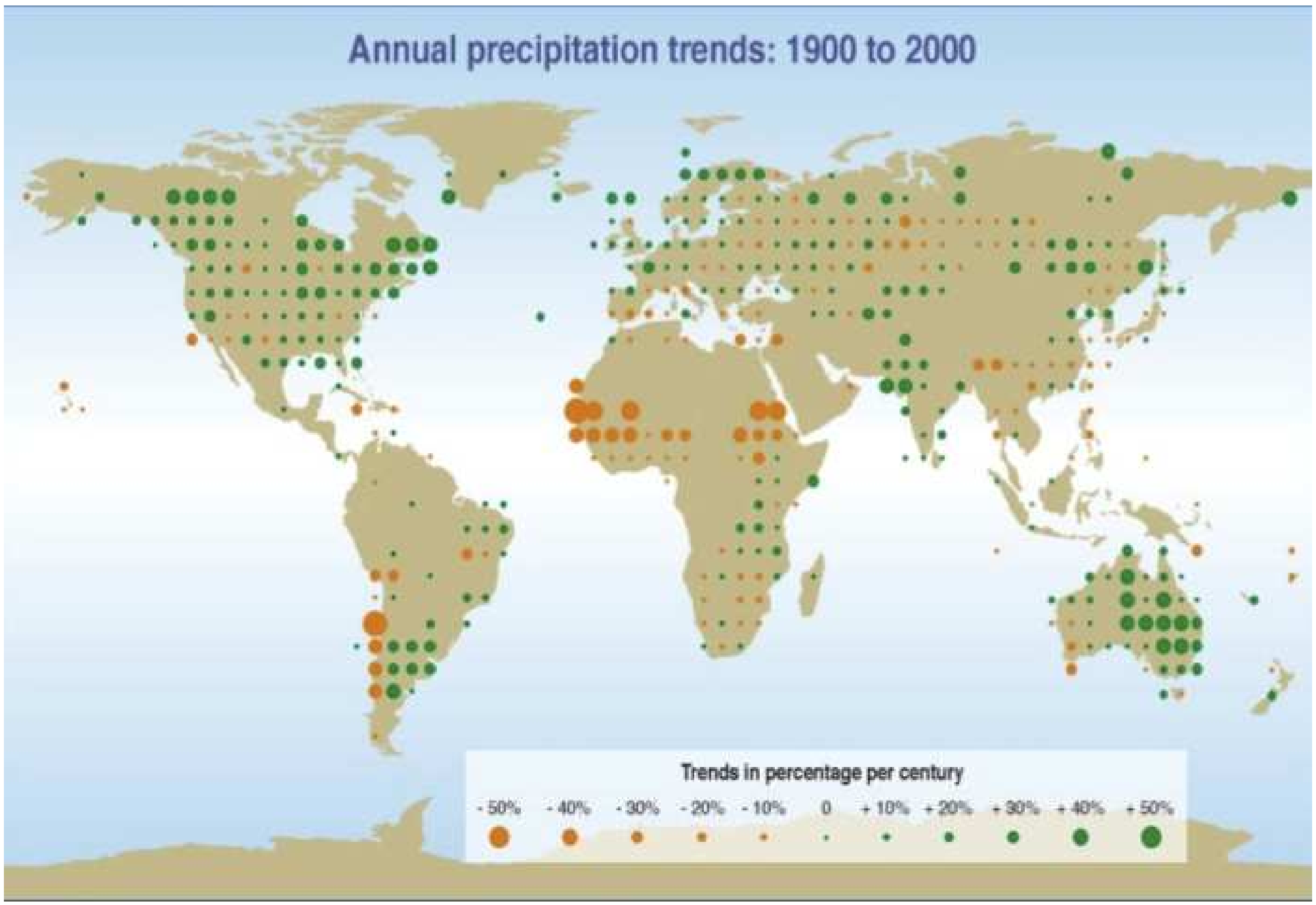
Ministry of Agriculture of Chile

CHILE AND THE CLIMATE CHANGE

- According to the IPCC, Chile is one of the countries which has been affected and which will continue to be affected by some of the changes predicted for the region.
- It is expected that by 2080, rainfall will fall by 30% compared to current levels.
- Productivity of some important crops and of livestock is projected to decrease, with adverse consequences for food security. Meanwhile, changes in precipitation levels and the disappearance of glaciers will have a significant impact on water availability for human consumption, agriculture and hydroelectricity.

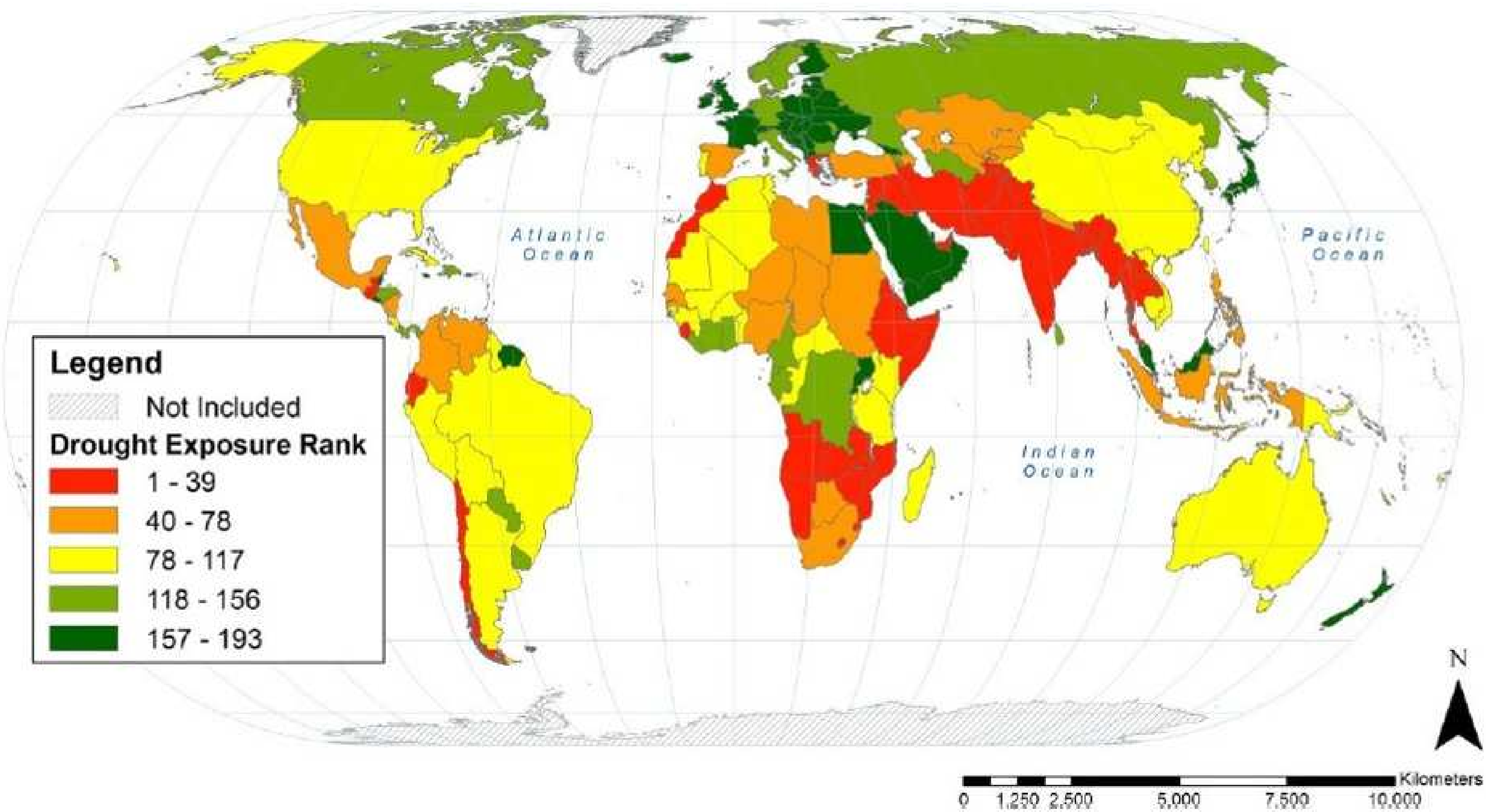
Source: National Climate Change Action Plan 2008-2012.

CHILE AND THE CLIMATE CHANGE



IPCC, 2014.

DROUGHT EXPOSURE



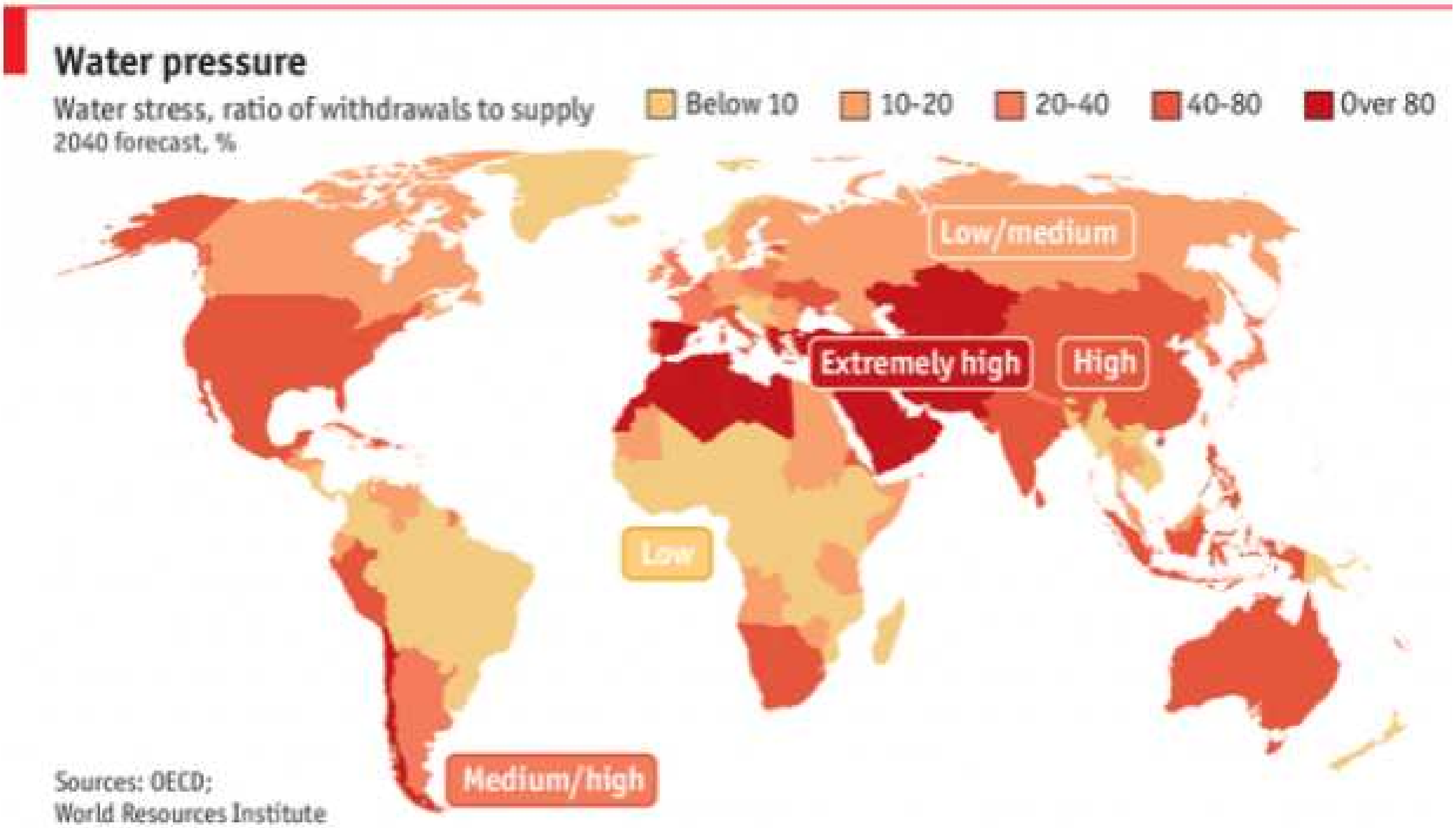
International Journal of Environmental Research and Public Health: *Climate-Related Hazards: A Method for Global Assessment of Urban and Rural Population Exposure to Cyclones, Droughts, and Floods: Elizabeth Christenson, Mark Elliott, Ovik Banerjee, Laura Hamrick and Jamie Bartram.*

COUNTRY RANKING BY TYPE OF DISASTER

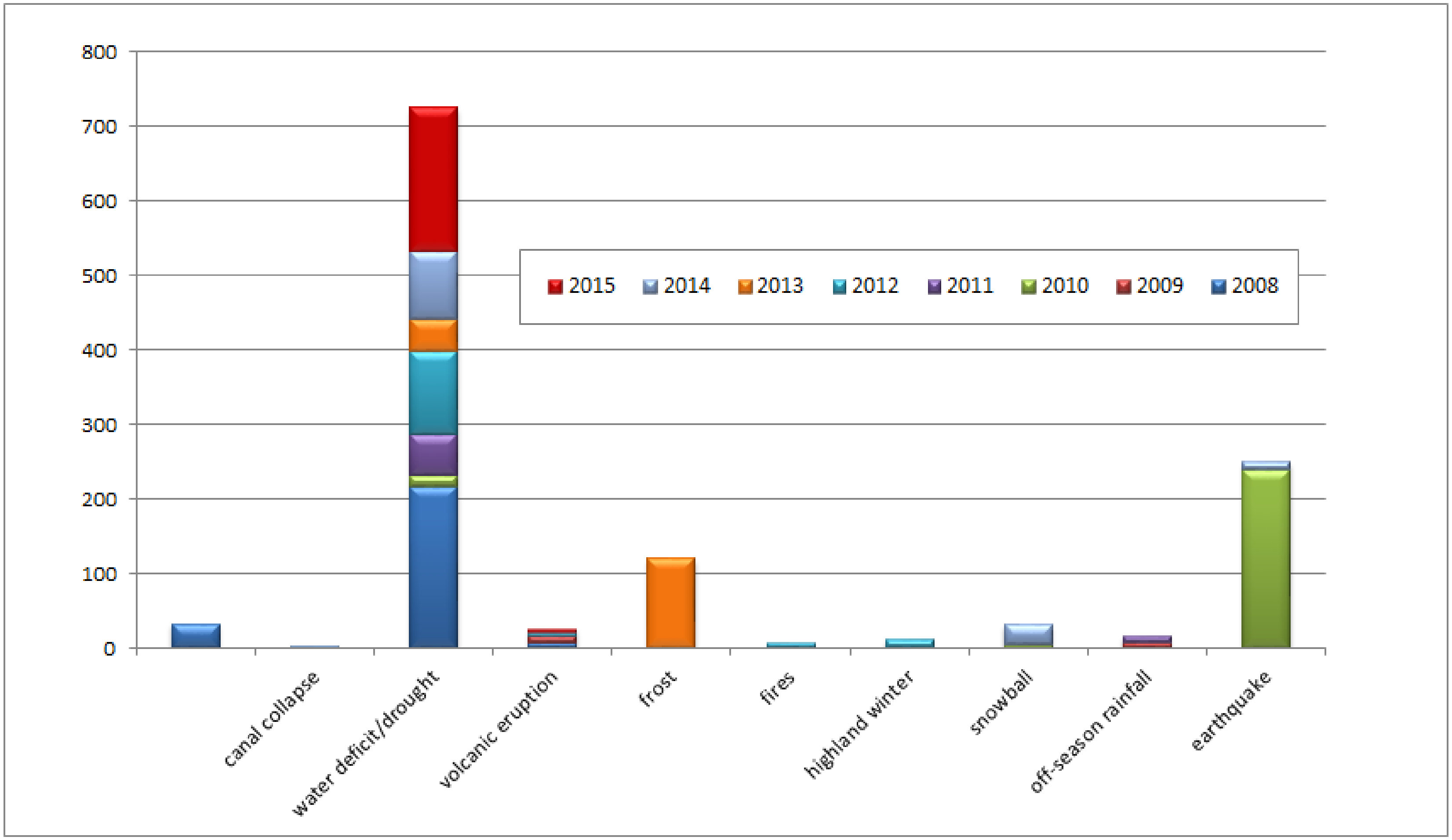
Country	Cyclone Rank	Country	Drought Rank	Country	Flood Rank
Guam	1	Gibraltar	1	Macao	1
Northern Mariana Islands	2	Lebanon	2	Bangladesh	2
Réunion	3	Malta	2	Hong Kong	3
Mauritius	4	Nauru	2	Jamaica	4
Hong Kong	5	Swaziland	2	Guatemala	5
New Caledonia	6	Saint Kitts and Nevis	6	Nepal	6
Japan	7	Djibouti	7	Liechtenstein	7
British Virgin Islands	8	Jordan	8	Singapore	7
Antigua and Barbuda	9	Myanmar	9	El Salvador	9
Macao	10	Guatemala	10	Honduras	10
Philippines	11	Syria	11	Sri Lanka	11
Madagascar	12	Zimbabwe	12	Vietnam	12
United States Virgin Islands	13	Eritrea	13	Haiti	13
Puerto Rico	14	Pakistan	14	Cambodia	14
Montserrat	15	Somalia	15	South Korea	15
Anguilla	16	Lesotho	16	Colombia	16
Guadeloupe	17	Iraq	17	Ecuador	17
Vanuatu	18	Chile	18	Kenya	18
Dominica	19	Kiribati	19	Rwanda	19
Saint Kitts and Nevis	20	Malawi	20	Thailand	20

Elizabeth Christenson et al.: Climate-Related Hazards: A Method for Global Assessment of Urban and Rural Population Exposure to Cyclones, Droughts and Flood. International Journal of Evironmental Research and Public Health, 2014

CHILE AND THE CLIMATE CHANGE

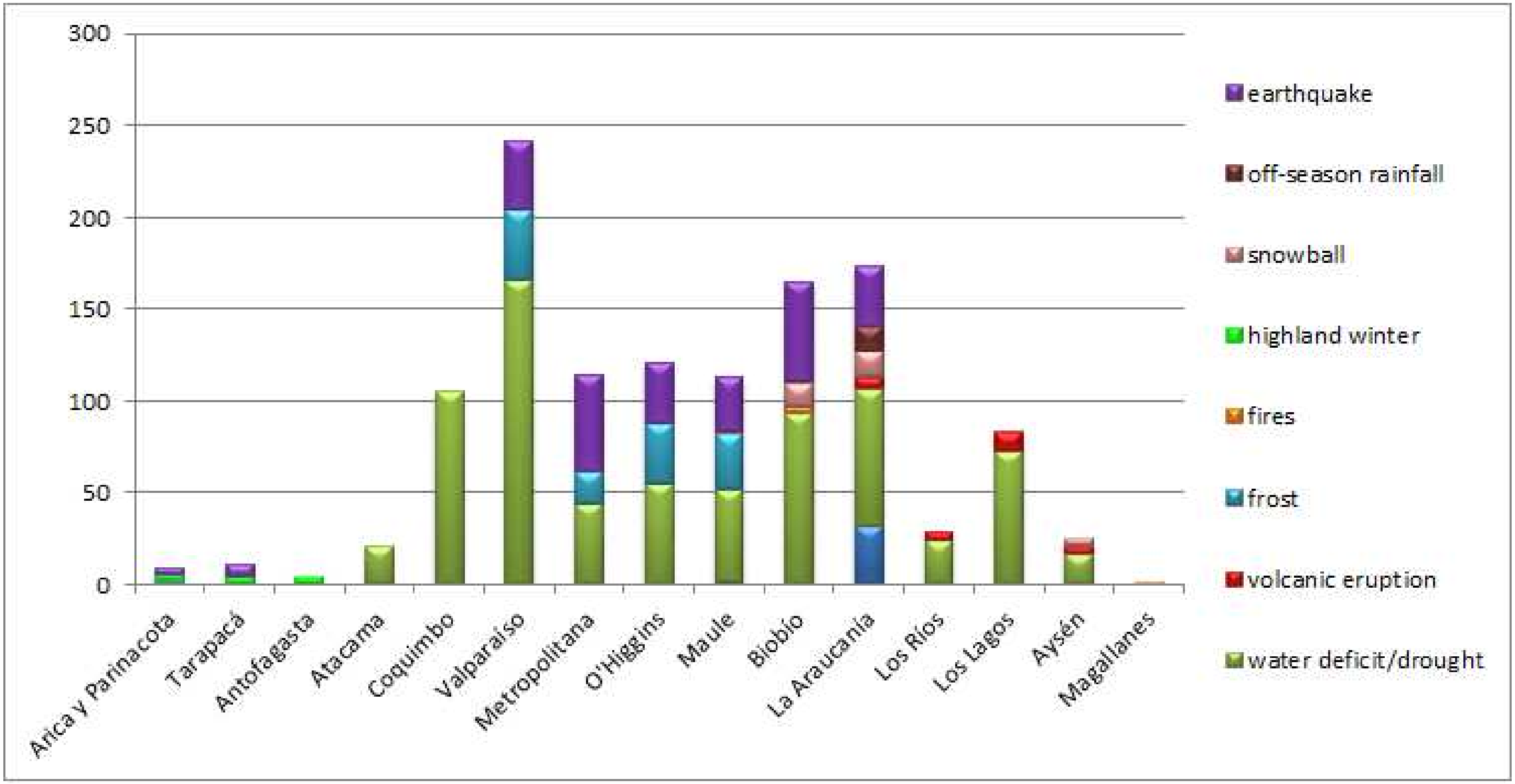


Number of communes with agricultural emergency declaration, by event (2008-2015)



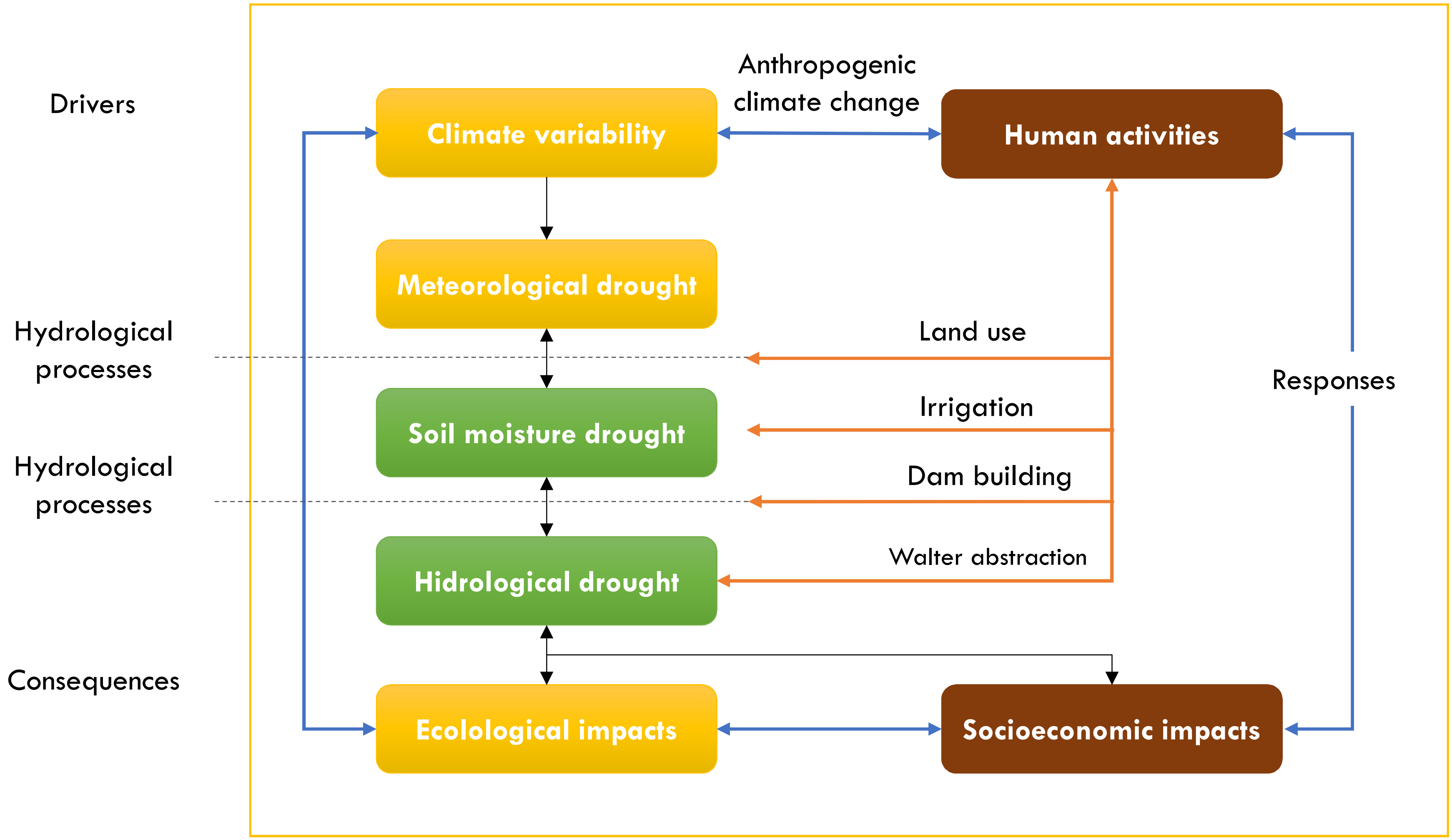
Source: UNEA, 2015.

Number of communes with declaration of agricultural emergency, By region (2008-2015)



Fuente: UNEA, 2015.

DROUGHT PROPAGATION



Source: Anne van Loon: Drought propagation in the Anthropocene. 2016.

RISK MANAGEMENT IN AGRICULTURE

- Risk management in agriculture is now an essential tool for farmers to anticipate, avoid and react to shocks. An efficient risk management system for agriculture will preserve the standard of living of those who depend on farming, strengthen the viability of farm businesses, and provide an environment which supports investment in the farming sector.
- Government policies should take a holistic approach to risk management, assessing all risks and their relationship to each other, and avoiding focussing on a single source of risk such as prices. Governments can help farmers to assess and manage their own risk by providing information and training.
- Agricultural risk management policies should focus on catastrophic risks that are rare but cause significant damage to many farmers at the same time. Contingency plans should define in advance the procedures, responsibilities and limits of the policy response.

Source: http://www.oecd.org/agriculture/, feb 2016.

CLIMATE RISK MANAGEMENT

- Risk management related to Climate is to broadcast appropriate information, through efficient management systems, to alert officials in order to guarantee food security and water availability, long before the real dangers occur.

  (Source: WHO, 2010).

- Using climate information in a multi-disciplinary sciencetific context to face climate impacts and the resources management problems for development .

  (Source: IRI, 2010).

RISK MANAGEMENT IN AGRICULTURE

- Building the resilience Nations and Communities to Disasters means reduction of economic, social, health, cultural and environmental lost in communities and countries.
- The goal declare at the Chart of the Sendai Framework for Disaster Risk Reduction 2015-2030 is "Prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience.

Source: Sendai Framework for Disaster Risk Reduction, 2015-2030, http://www.preventionweb.net/drr-framework/sendai-framework, feb 2016.

CLIMATE RISK MANAGEMENT

- The climate risk management consider the followings aspects related to risk management process:
  - Climate risk assessment for decision making
  - Climate risk reduction: planning and preparedness
  - Distribution, common set and transferring of risks under the adaptation context.

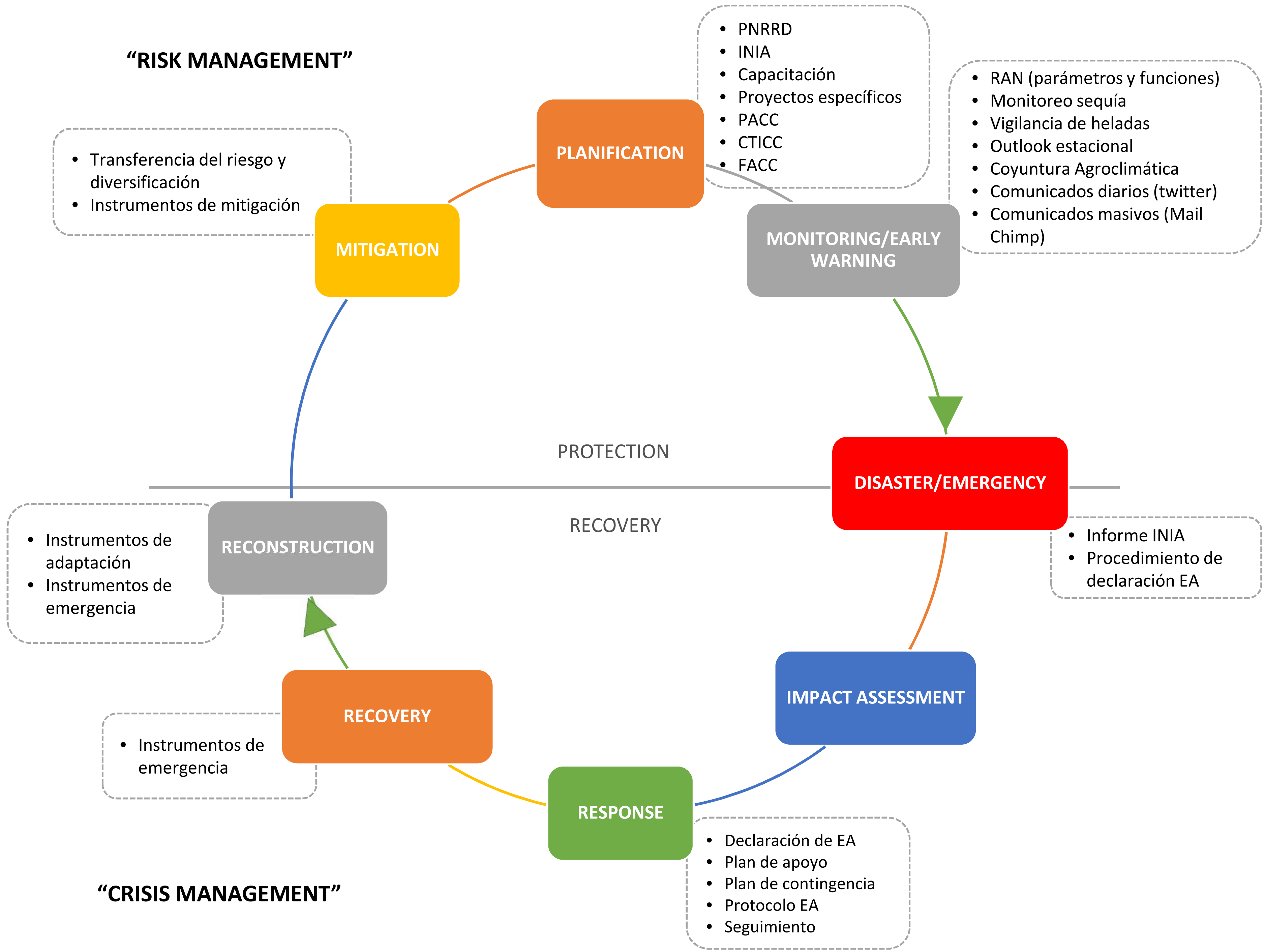
  (Source: UNFCC, 2011).

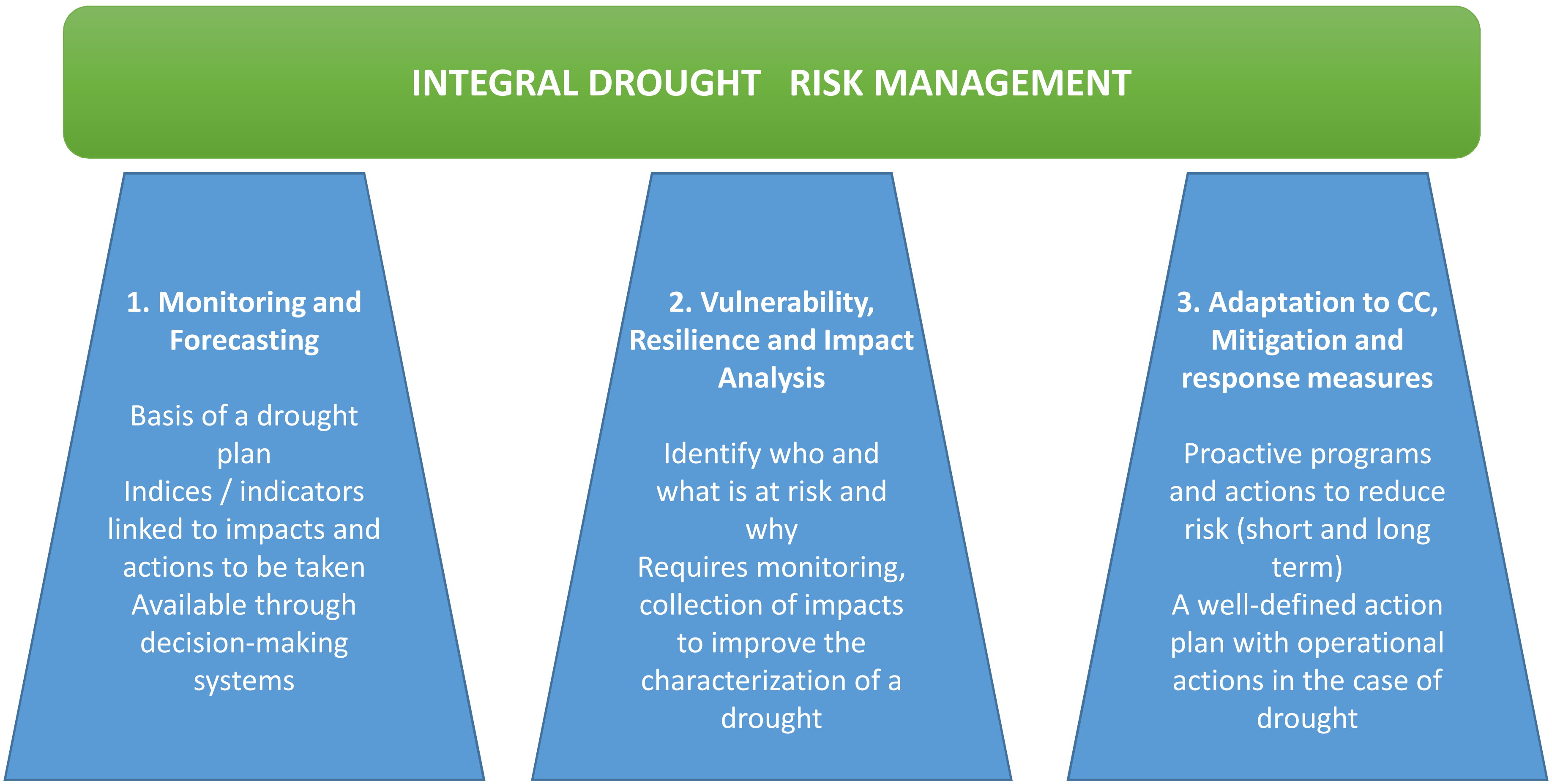
- Hazards and oportunities assessment coming from climate variability (present and future), including those of climate change, to be set at the design of plans and projects.

  (Source: World Bank, 2006).

$$\text{RISK} = \frac{\text{HAZARDS Frequency and magnitute of events} \times \text{VULNERABILITY Susceptibility of impacts of hazards}}{\text{CAPACITY Present resources and ability to prepare for the future}}$$

RISK	The probability of harmful consequences, or expected losses (deaths, injuries, property, livehoods, economic activity discrupted or environment damaged) resulting form interactions between hazards and vulnerable conditions.
HAZARD	A pottentialy damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property, damage, social and economic disruption or environmental degradation.
VULNERABILITY	The conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards.
CAPACITY	A combination of all the strengths and resources available within a community, society or organization tha can rduce the level of risk, or the effects of a disaster.


"RISK MANAGEMENT"
PLANIFICATION
• PNRRD
• INIA
• Capacitación
• Proyectos específicos
• PACC
• CTICC
• FACC
• RAN (parámetros y funciones)
• Monitoreo sequía
• Vigilancia de heladas
• Outlook estacional
• Coyuntura Agroclimática
• Comunicados diarios (twitter)
• Comunicados masivos (Mail Chimp)
MONITORING/EARLY WARNING
• Transferencia del riesgo y diversificación
• Instrumentos de mitigación
MITIGATION
PROTECTION
DISASTER/EMERGENCY
RECOVERY
• Informe INIA
• Procedimiento de declaración EA
RECONSTRUCTION
• Instrumentos de adaptación
• Instrumentos de emergencia
IMPACT ASSESSMENT
RECOVERY
• Instrumentos de emergencia
RESPONSE
• Declaración de EA
• Plan de apoyo
• Plan de contingencia
• Protocolo EA
• Seguimiento
"CRISIS MANAGEMENT"


INTEGRAL DROUGHT RISK MANAGEMENT
1. Monitoring and Forecasting
Basis of a drought plan
Indices / indicators linked to impacts and actions to be taken
Available through decision-making systems
2. Vulnerability, Resilience and Impact Analysis
Identify who and what is at risk and why
Requires monitoring, collection of impacts to improve the characterization of a drought
3. Adaptation to CC, Mitigation and response measures
Proactive programs and actions to reduce risk (short and long term)
A well-defined action plan with operational actions in the case of drought

RISK MANAGEMENT GOVERNANCE

Integrated Risk Management
(D G I R)

Information, Monitoring and Prevention

- Agromet/nز RAN
- Agroclimatic Observatory
- Adaptation Practices y Proyects for Prevention
- Training and communication strategy and social networks for monitoring and prevention.

Development and promotion of risk transfer tools.

- Insurance and Prices coverage.
- Territorial Insurance for emergencies.

Disaster Response

- Platform for tracking commitments.
- Spatial Data infraestructure. (IDE)
- Standarized Reports I yII by Risk/ APP de DRM.

ACTION FRAMEWORK OF THE SUB DEPARTMENT OF INFORMATION, MONITORING AND PREVENTION FOR INTEGRATED RISK MANAGEMENT – MINISTRY OF AGRICULTURE OF CHILE

Monitoring and Information:

- Agroclimatic Observatory: Maproom y Data Library.
- Agromet: National Agroclimatic network. (354 AMS).
- Seasonal Outlook.
- Agroclimatic Newsletter
- Drought Monitoring Matrix.
- Agroclimatic Web Portal
- Agreements/Partners: INIA, CAZALAC, IRI, DMC, CRAN, DGA, FAO, UNESCO, CEAZA, CIREN

Agricultural emergencies

- Protocol Application for the agricultural emergency declaration procedure: pre-emergency components.
- Support Plan for the contingency
- Institutional early coordination

Regional Comissions of Integrated Risk Management

- Coordination at regional level for the prevention, information and monitoring of main risks.
- Monitoring and support for the implementation of Risk Management Work Plans.
- Support to the regional procedure of agricultura emergency declaration at regional level.

Training

- Training related to Risk Management RM, use of the information and monitoring tools for RM, instruments and practices of adaptation and mitigation:
- E-learning courses
- Classroom courses
- Workshops
- Collaborative training iniciatives with other institutions
- Printed and audiovisual material
- National and International Seminars

National Platform for Disaster Risk Management DRM

- Policymaking and Strategy Formulation of DRM
- Participation in working groups of the National Platform for DRM
- DRM Training
- Focal point: ONEMI

Specific Projects

- SECANO Project (TCP/CHI/3403 FAO) – Dryland, arid and semi-arid areas
- Project: "Supporting Effective Drought Risk Management in Vulnerable Catchments of Chile" (British Council Newton-Picarte Fund)
- Project of the Adaptation Fund: Enhancing Resilience to Climate Change of the Small Agriculture in the Chilean Region of O´Higgins
- JICA Project: capacity building on DRM

Climate Change

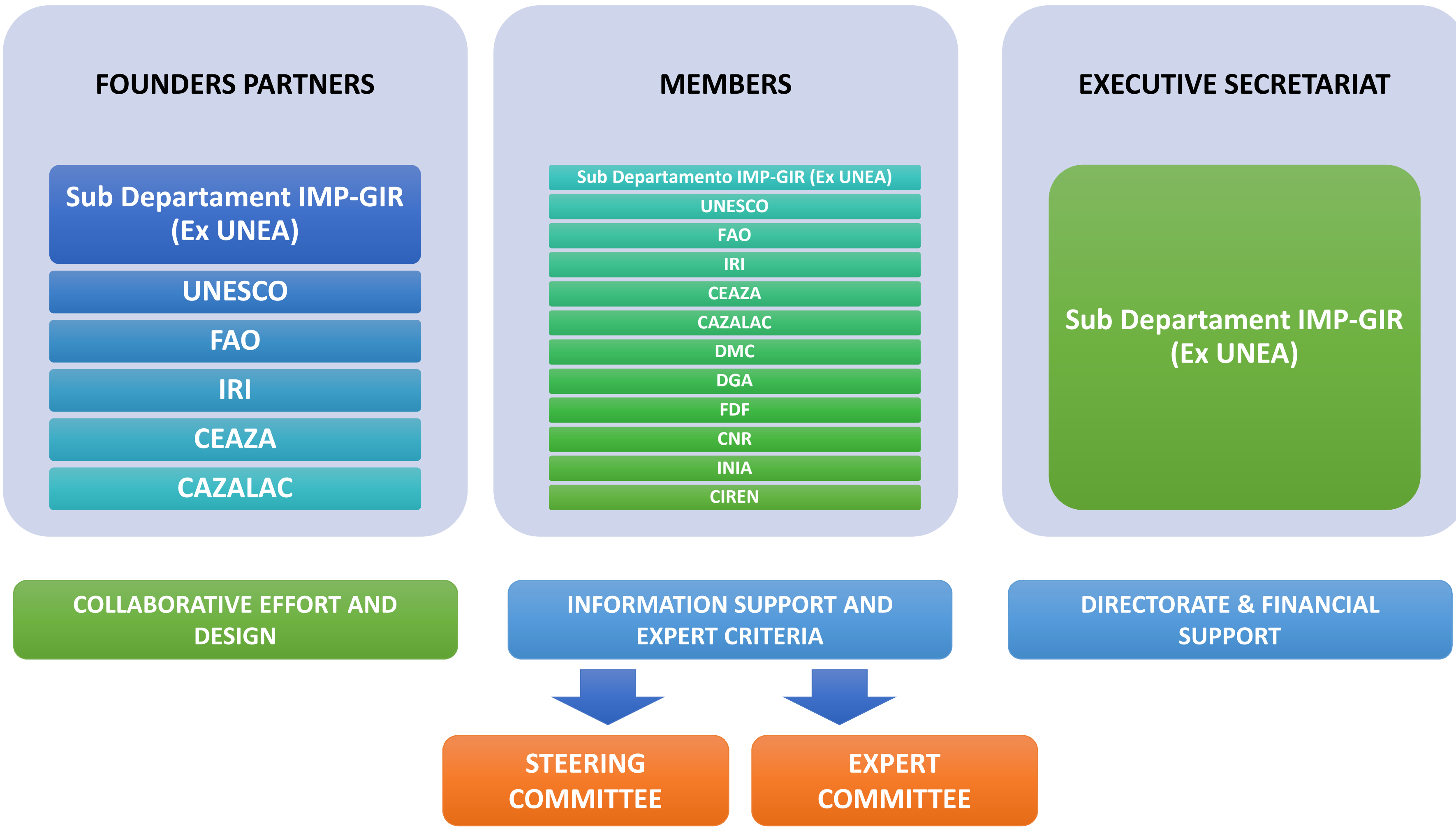
- To contribute to adaptation by climate risk management:
- National Adaptation Plan for Climate Change (Measure N°4)
- Intraministerial Technical Committe of Climate Change
- Adaptation Fund for Climate Change Project

AGROCLIMATIC OBSERVATORY*

- Characteristics:
  - Developed by collaborative work
  - Multi-stakeholders participation
  - Free of barriers - information access (no cost, no password)
  - Integrated approach for the information:
    - different time scales (short term to long term, past to the future)
    - different levels of information (farmers, authorities, consultants, researchers, etc.)
    - Multiple sources of information: National Agroclimatic Network (National Agroclimatic Network, (RAN), in coordination with a Private Consortium); General Direction of Water (DGA of Ministry of Public Works); Meteorological Direction of Chile (DMC of the National Direction of Civil Aeronautic); and National Institute for Agricultural Researches (INIA of the Ministry of Agriculture).

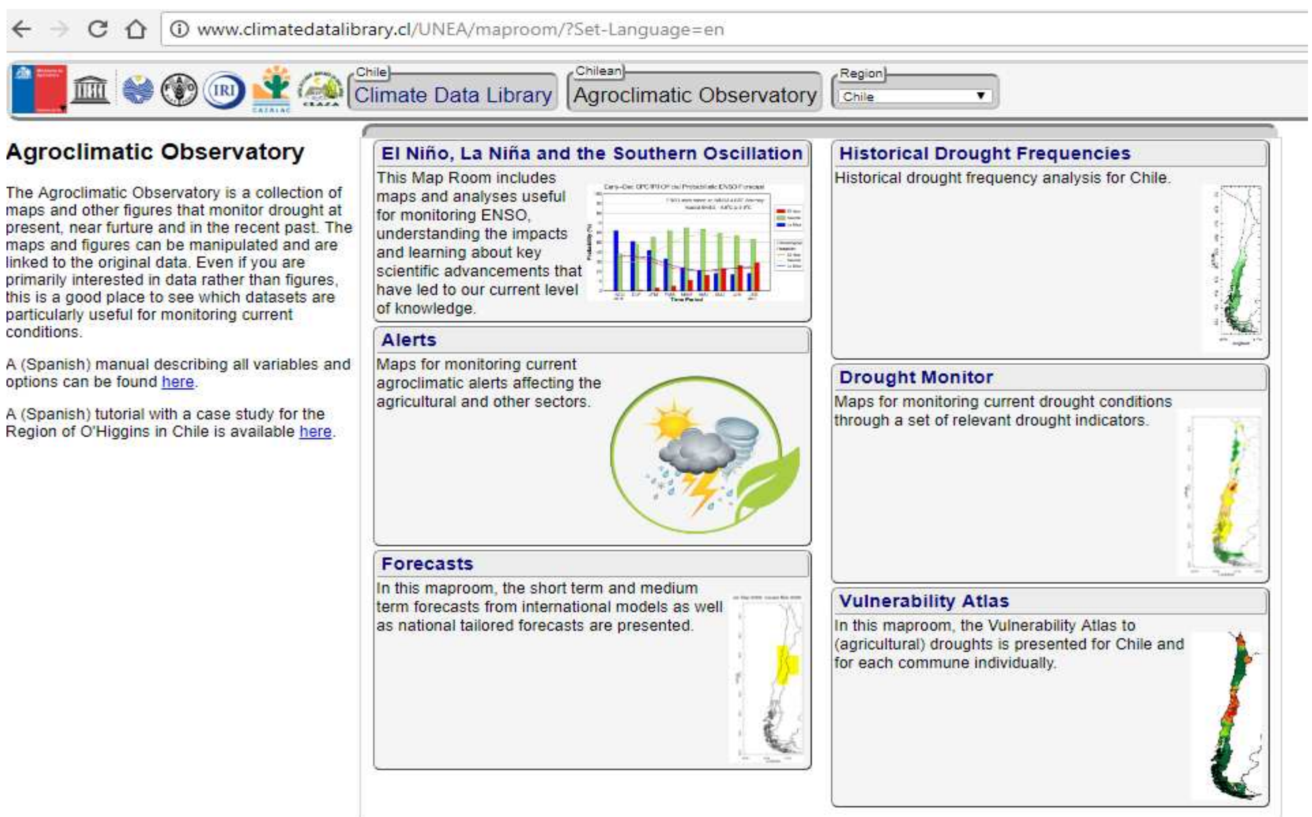
** Presented as a new publication in the Knowledge Forum on Water Security and Climate Change: Innovative solutions for sustainable water resources management; UNESCO – Paris, France; 18 – 20 October 2017*

GOBERNANCE OF THE AGROCLIMATIC OBSERVATORY



THE AGROCLIMATIC OBSERVATORY

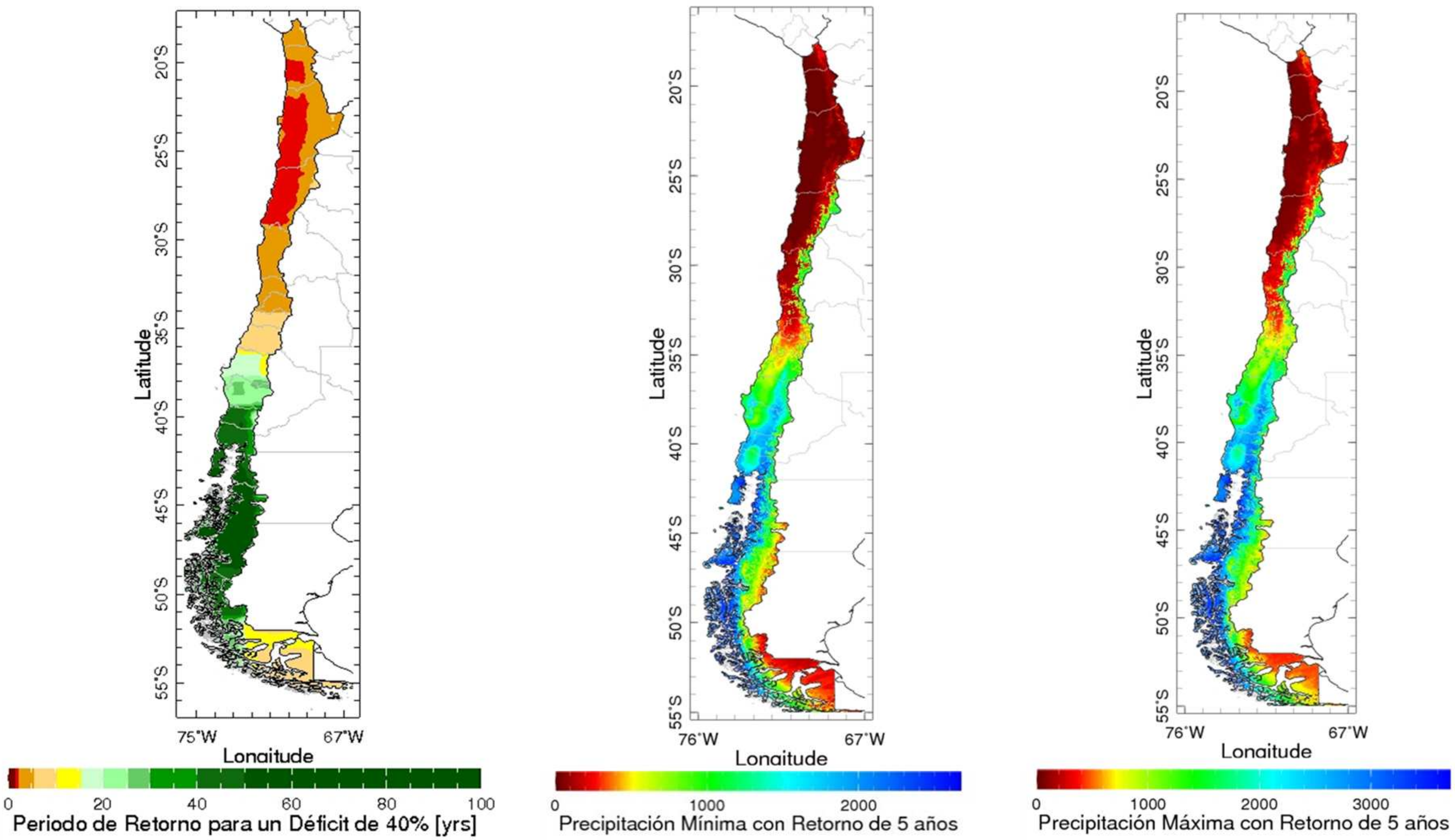
- The Agroclimatic Observatory is an important decision-making tool for integrated risk management.



THE AGROCLIMATIC OBSERVATORY

IDENTIFING DOUGHT RISK

THE DROUGHT ATLAS

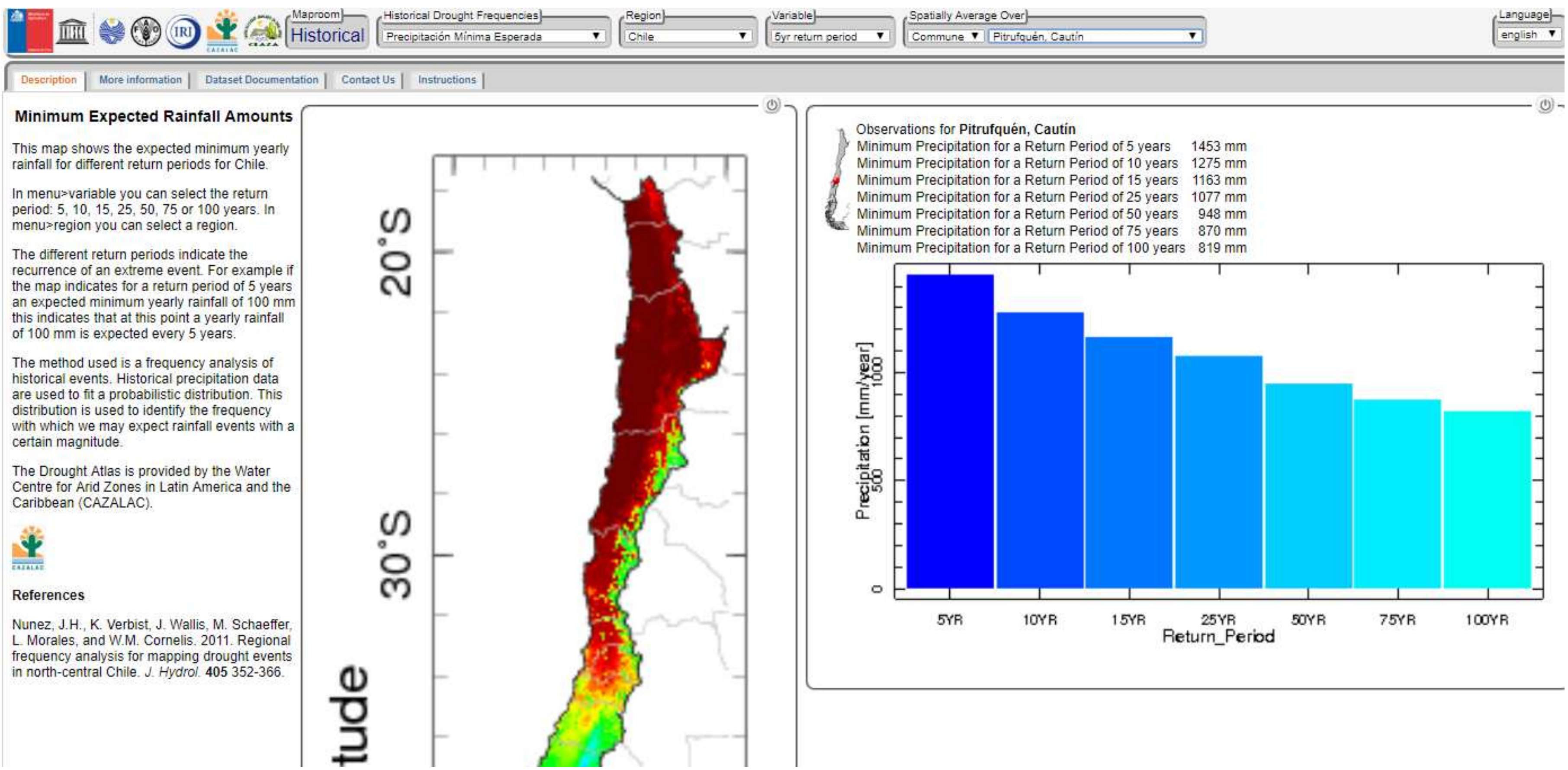


Atlas of Droughts showing a) The frequency of droughts, b) the minimum precipitation and c) the maximum precipitation expected every 5 years

THE AGROCLIMATIC OBSERVATORY

IDENTIFING DOUGHT RISK

THE DROUGHT ATLAS

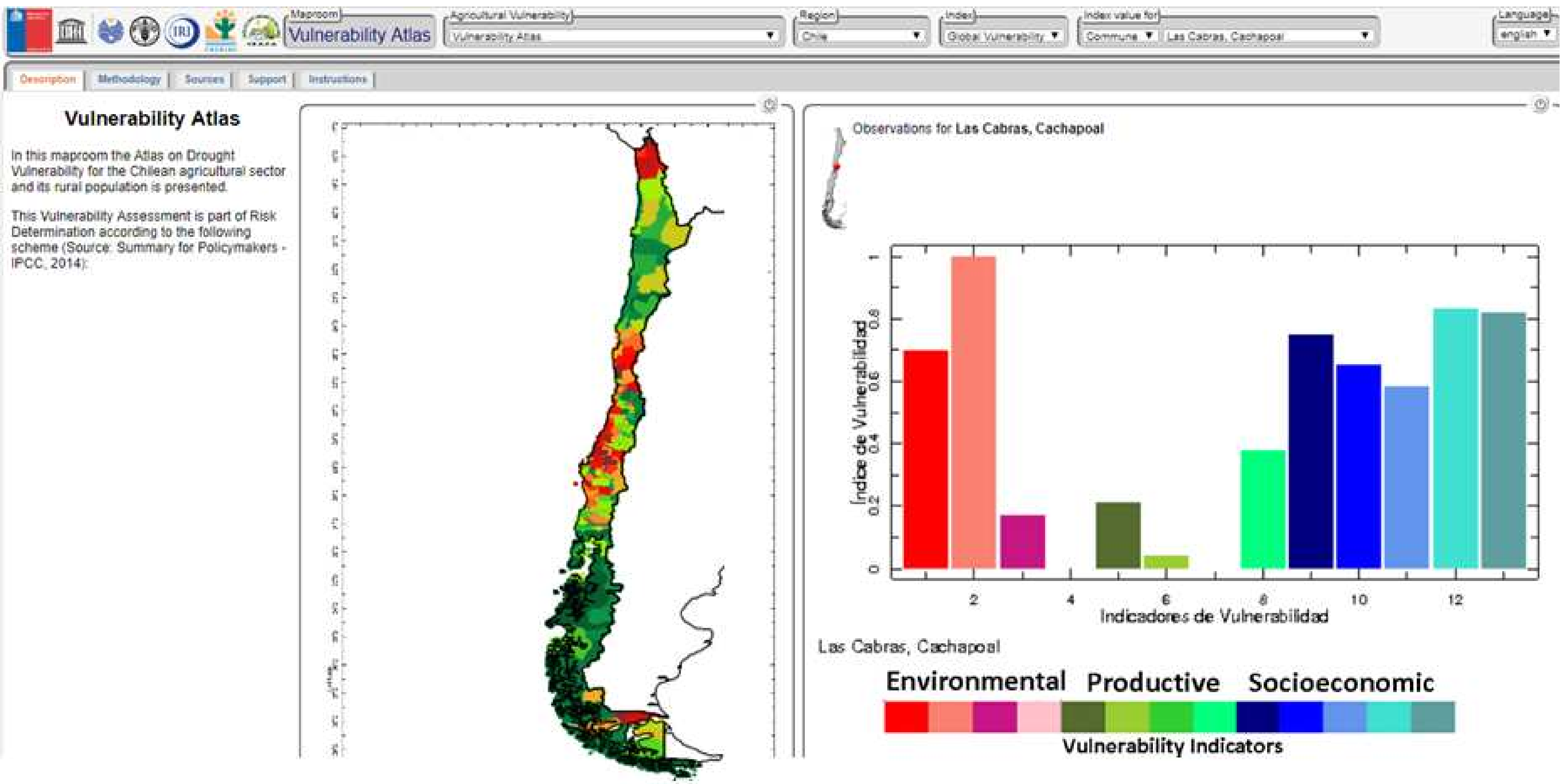


The Atlas of Droughts integrated in the Agroclimatic Observatory, showing precipitations for different periods of return in the commune of Pitrufquén, Region of the Araucanía.

THE AGROCLIMATIC OBSERVATORY

IDENTIFING DOUGHT RISK

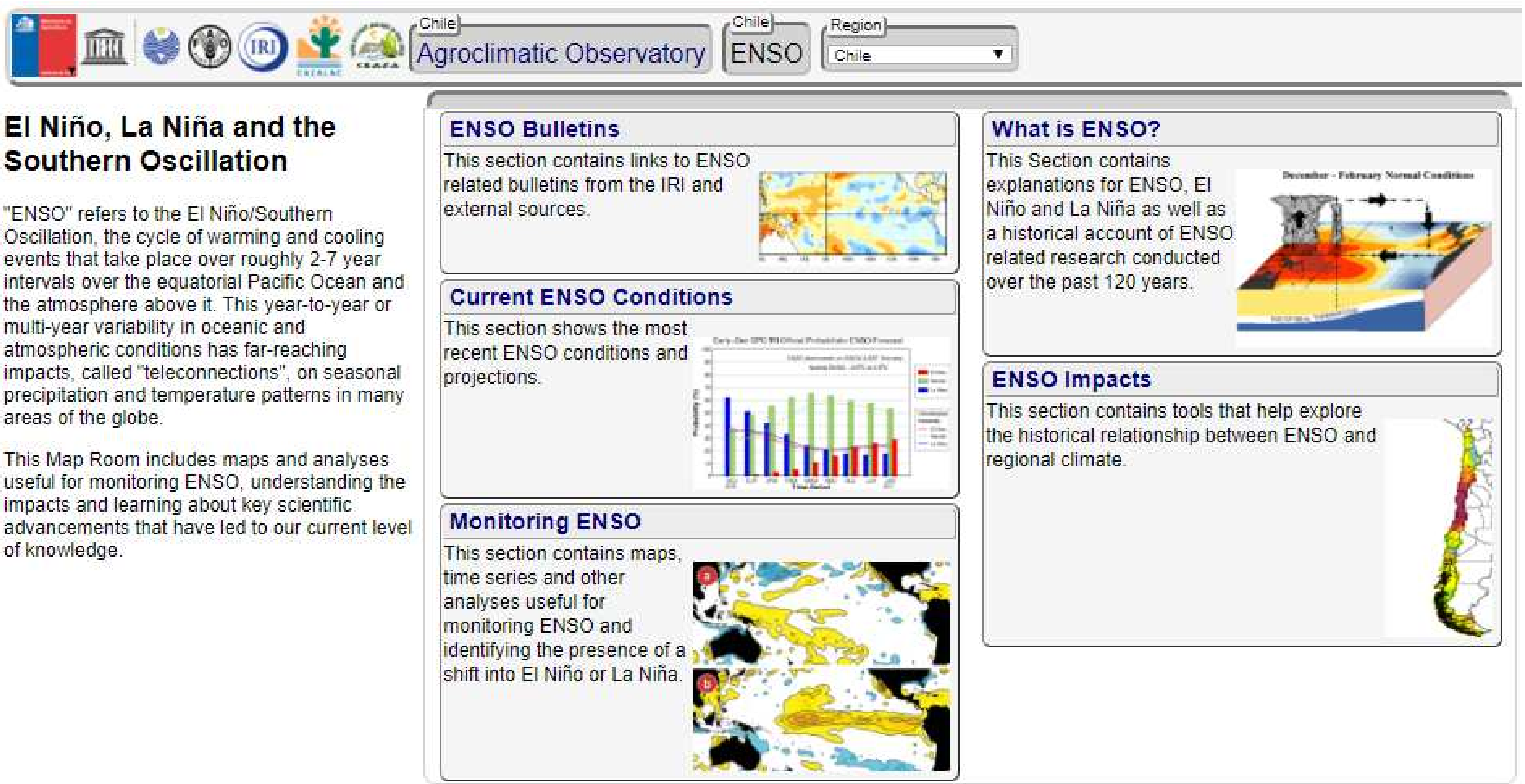
VULNERABILITY ATLAS



The Atlas of Vulnerability integrated in the Agroclimatic Observatory, with an example of detailed analysis for the commune of Las Cabras in the Region of O'Higgins.

THE AGROCLIMATIC OBSERVATORY
MONITORING AND DROUGHT EARLY WARNING

EL NIÑO Y LA NIÑA



The component of the Agroclimatic Observatory covering the monitoring and impact of El Nino y La Nina

THE AGROCLIMATIC OBSERVATORY
MONITORING AND DROUGHT EARLY WARNING

EL NIÑO Y LA NIÑA

Chile ENSO | ENSO: Current ENSO Conditions ▼

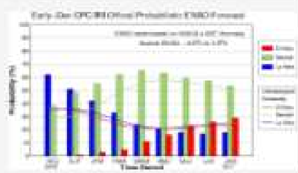
Current ENSO Conditions

This section shows the most recent ENSO conditions and projections.

In this section, current information and graphs are shown from the International Research Institute for Climate and Society (IRI) and the NOAA Climate Prediction Center (CPC).

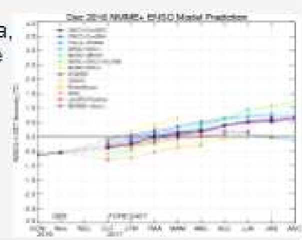
What is the current forecast of ENSO Conditions?

This graph shows the probability of El Niño, La Niña, or neutral conditions for the next six month.



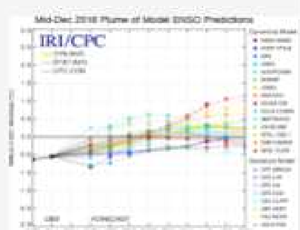
How has ENSO evolved over the last years and months?

This graph shows the evolution of El Niño, La Niña, and neutral conditions since 1982 until present.



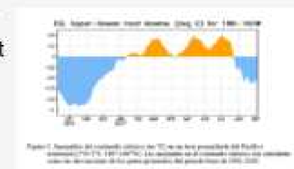
What are the different ENSO model projections?

This graph shows the different model projections for El Niño, La Niña, or neutral conditions for statistical and dynamical models.



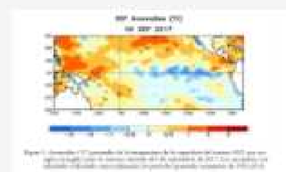
What is the recent evolution of the Equatorial Ocean Heat?

This graph shows the evolution of the anomaly of the ocean heat over the last 12 months for the whole cross section of the the Pacific Ocean.



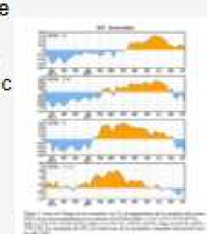
What is the current condition of the Sea Surface Temperature?

This graph shows the anomaly of the sea surfae temperature in the Pacific Ocean, and allows identifying typical Niño or Niña patterns.



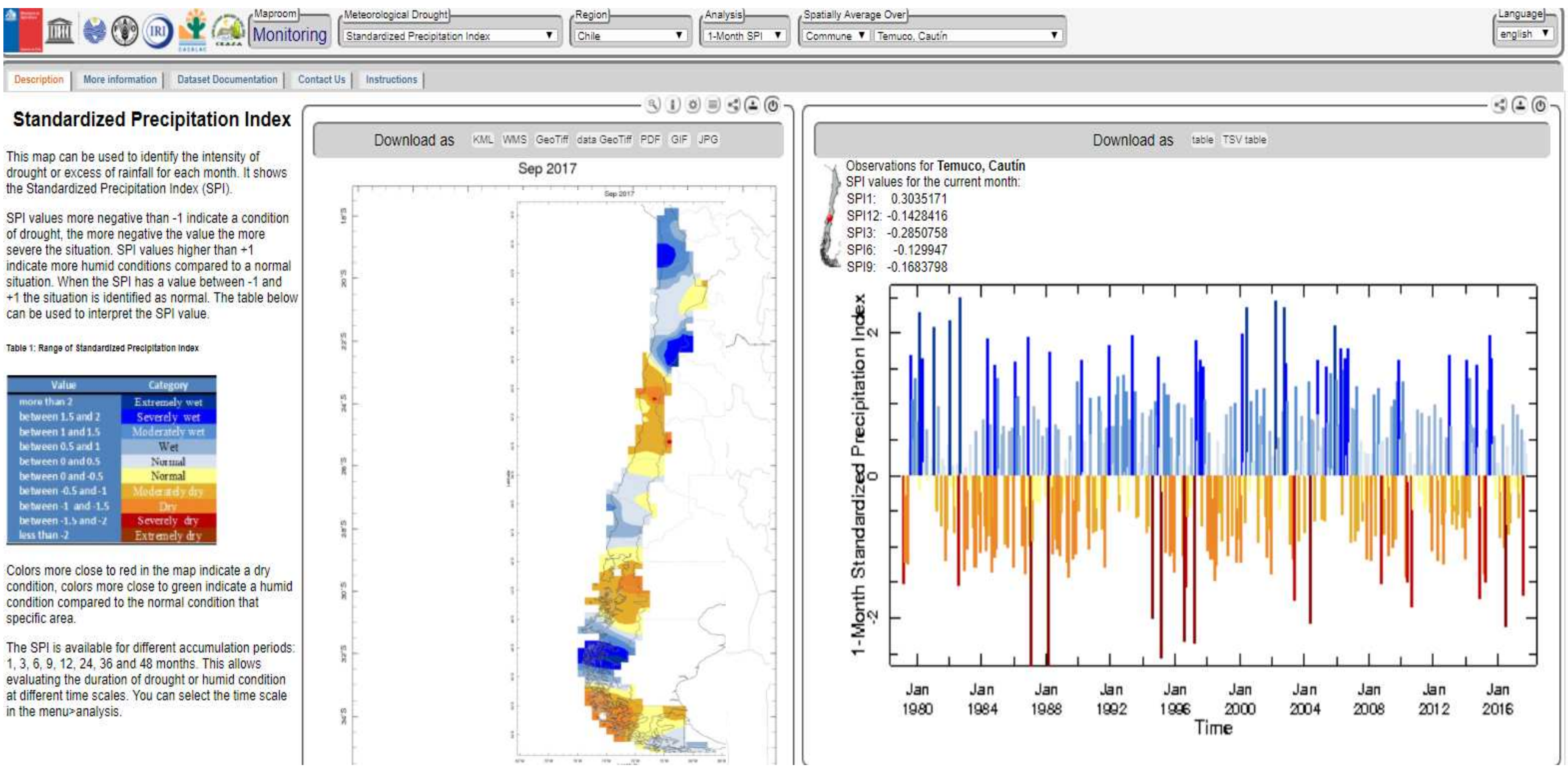
What is the recent evolution of the Sea Surface Temperature?

This graph shows the evolution of the anomaly of the sea surfae temperature over the last 12 months for different sections of the the Pacific Ocean.



THE AGROCLIMATIC OBSERVATORY
DROUGHT MONITORING

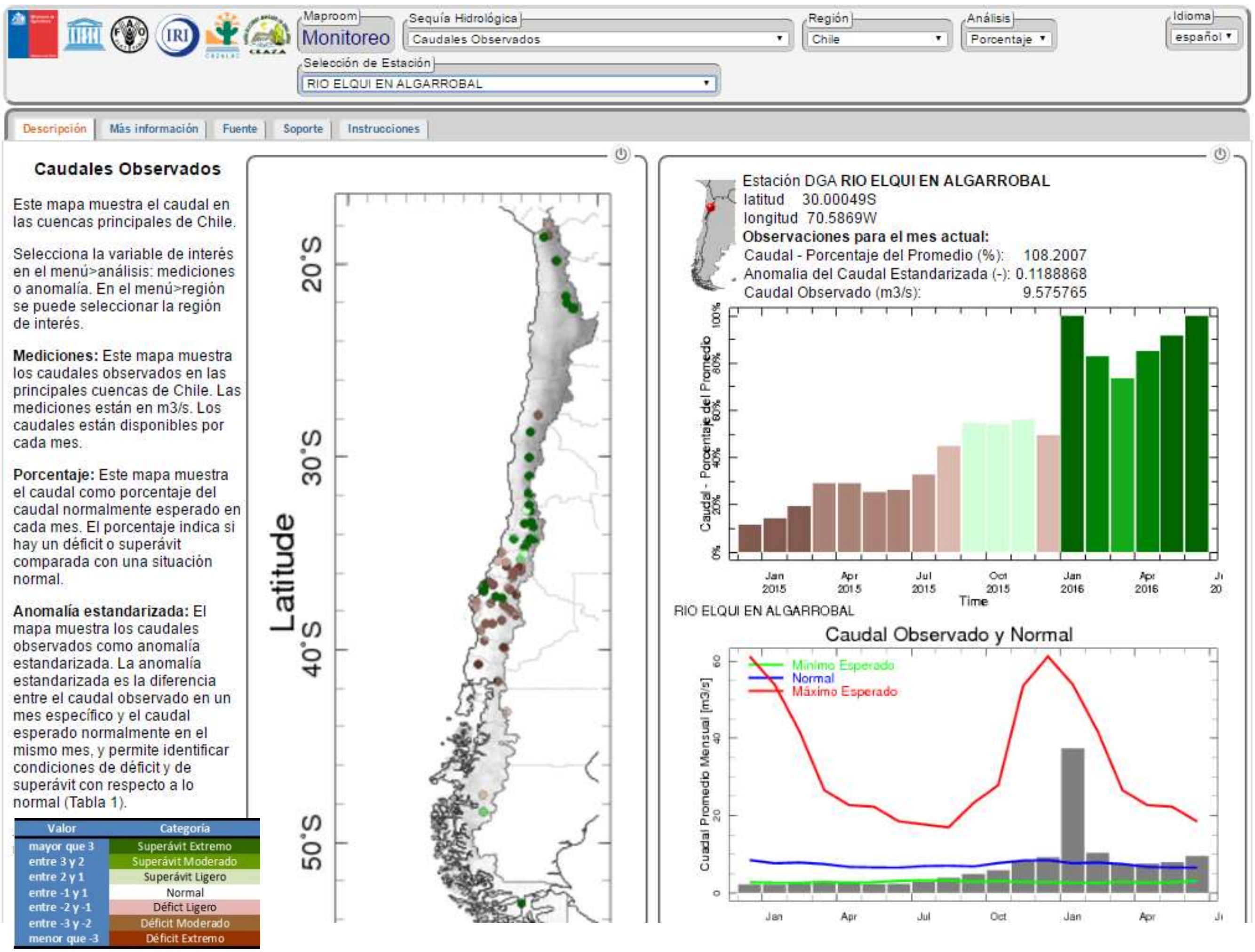
METEOROLOGICAL DROUGHT



Index of the Standardized Precipitation (SPI), with the time series for the Commune of Temuco

THE AGROCLIMATIC OBSERVATORY
DROUGHT MONITORING

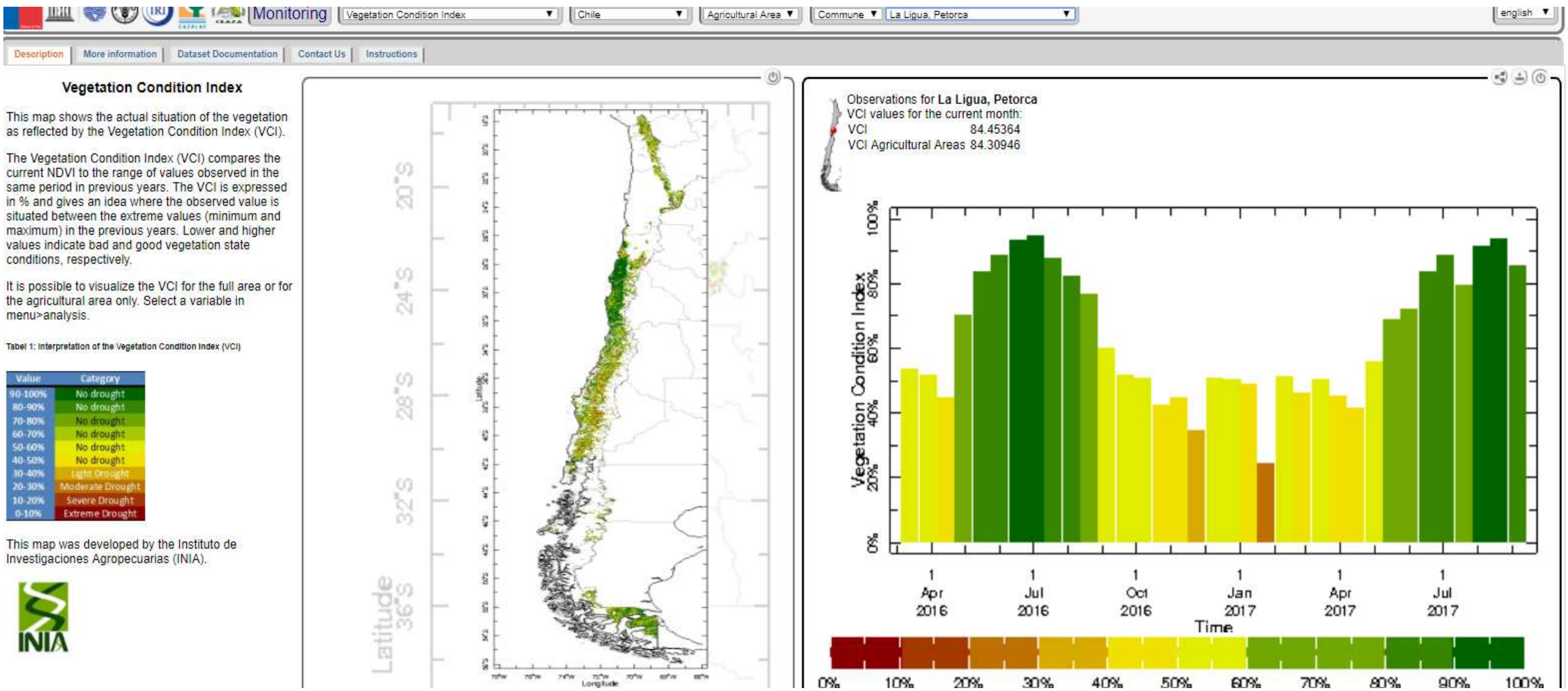
HYDROLOGICAL DROUGHT



THE AGROCLIMATIC OBSERVATORY

DROUGHT MONITORING

AGRICULTURAL DROUGHT



VCI= VEGETATION CONDITION INDEX

ACTIONS/PRODUCTS

COYUNTURA AGROCLIMÁTICA

AGOSTO 2017

Sub Departamento de Información, Monitoreo y Prevención IMP – Ministerio de Agricultura

Tabla de contenido

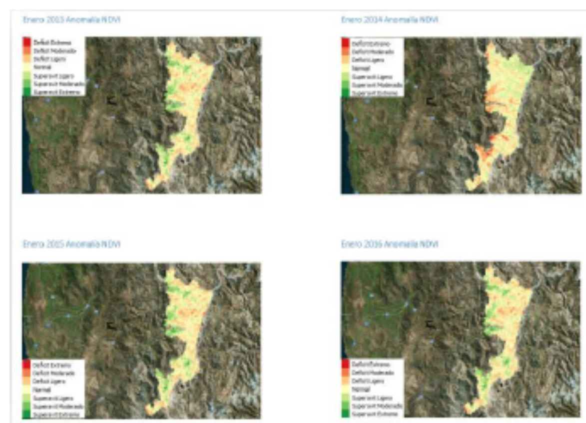
DROUGHT MONITORING MATRIX - OCTOBER 2017*

	ARICA Y PARINACOTA	TARAPACÁ	ANTOFAGASTA	ATACAMA	COQUIMBO	VALPARAÍSO	METROPOLITANA	O'HIGGINS	MAULE	BIOBÍO	ARAUCANÍA	LOS RÍOS	LOS LAGOS	AYSEN	MAGALLANES
1. Meteorological drought															
Deficit (surplus) of precipitation (30.09).DGA/DMC	>100	>100	>100	>100	80	3	-24	-20	-5	-23	4	-5	10	40	-36
Return Period Deficit Regional Level (years). (AO)							2-6	2-6		4					14
Standardized Precipitation Index SPI - september (AO. NOAA-CPC).	Putre	Colchane	Calama	Copiapó	Montepatria	Quillota	Paine	San Vicente	Talca	Chillan	Temuco	Paillaco	Puerto Montt	Coyhaique	Punta Arenas
SPI-3	1,07	0,81	-0,09	0,26	-1,05	-0,26	-0,44	-0,02	0,15	-0,29	-0,29	0,23	0,19	1,52	-1,07
SPI-6	0,79	0,99	0,48	1,24	1,12	0,63	-0,19	0,19	0,10	-0,87	-0,13	0,05	0,13	1,30	-1,36
SPI-12	-1,05	-0,03	-0,10	1,23	0,88	0,61	-0,28	0,06	-0,11	-1,18	-0,14	0,06	-0,16	0,07	[illegible]
2. Hydrological drought															
Watershed Irrigation Forecast (DGA)				Irrigation without restrictions	Irrigation without restrictions	Irrigation with restrictions (**)	Irrigation with secure availability	Irrigation with restrictions (**)	Irrigation with restrictions (**)	Irrigation with secure availability					
% Excedence Probability of Streamflow (DGA)				19-21	30-69	64-85	58-85	82-84	82-91	85					
				Copiapó	Elqui	Aconcagua	Mapocho	Cachapoal	Teno (***)	Ñuble					
				Huasco	Hurtado	Juncal	Colorado	Claro (Rengo)	Claro (Talca)						
					Grande	Putaendo	Maipo	Tinguiririca	Maule						
					Choapa										
3. Agricultural Drought															
Vegetation Condition Index (VCI). (INIA). (%). (august 29th to september13th). Regional averages.	NO DROUGHT 61	NO DROUGHT 61	NO DROUGHT 68	NO DROUGHT [illegible]	NO DROUGHT [illegible]	NO DROUGHT 93	NO DROUGHT 69	NO DROUGHT 61	NO DROUGHT 60	NO DROUGHT 94	NO DROUGHT 60	NO DROUGHT 71	NO DROUGHT 62	NO DROUGHT 77	NO DROUGHT 71

(*) Elaborated by Sub-Departament of Information, Monitoring and Prevention - DGIR. (Ministry of Agriculture).
(**)= It is recommended to make optimal use of the resource.
(***)= Teno river. Severe limitations.
(AO)= Agroclimatic Observatory.
DGA or General Water Management [Dirección General de Aguas in spanish].
INIA or Institute of Agricultural Research [Instituto de Investigaciones Agropecuarias in spanish].

SPI (NOAA-CPC):

< -2,00	Sequía extrema
[illegible]	Sequía severa
-1,499 a -1,00	Sequía moderada
-0,999 a 0,00	Sequía suave
> 0,00	Sin sequía



DROUGHT MONITORING MATRIX - OCTOBER 2017*

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SPI-6	0,79	0,99	0,48	1,24	1,12	0,63	-0,19	0,19	0,10	-0,87	-0,13	0,05	0,13	1,30	-1,36
SPI-12	-1,05	-0,03	-0,10	1,23	0,98	0,61	-0,28	0,06	-0,11	-1,10	-0,14	0,06	-0,16	0,97	-1,88
2. Hydrological drought															
Watershed Irrigation Forecast (DGA)				Irrigation without restrictions	Irrigation without restrictions	Irrigation with restrictions (**)	Irrigation with secure availability	Irrigation with restrictions (**)	Irrigation with restrictions (**)	Irrigation with secure availability					
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					Choapa										
3. Agricultural Drought															
Vegetation Condition Index (VCI). (INIA). (%). (august 29th to september13th). Regional averages.	NO DROUGHT 61	NO DROUGHT 61	NO DROUGHT 68	NO DROUGHT 91	NO DROUGHT 84	NO DROUGHT 50	NO DROUGHT 63	NO DROUGHT 61	NO DROUGHT 60	NO DROUGHT 54	NO DROUGHT 60	NO DROUGHT 71	NO DROUGHT 62	NO DROUGHT 77	NO DROUGHT 71

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> 0,00	Sin sequía

ABSTRACT OF SWOT ANALYSIS OF THE AGROCLIMATIC OBSERVATORY

SWOT ANALYSIS

STRENGTH

-The main strength is the integration of a wide range of information relevant to agroclimatic risk management, provided by different institutions in the country and abroad.

- Information from different formats in one place.

- Past, present and future analysis, plus alerts, available.

- Discussion space between different institutions (public and private).

- Recognized and validated internationally.

WEAKNESS

- System is very slow and graphic interface is not very friendly; many clicks to get a desired product.

- Unique server: damage risk or lose.

- It is required to implement an adequate and modern computer equipment and informatic specialists for data process.

- The responsibility that all works well it is supported only by agreement between institutions.

OPPORTUNITY

Local/regional observatories dynamics and flexibles, managed at regional level.

Generation of applications for cellphone will permit to improve the usability and access to data from Observatory.

Multipurpose useful (water resources, soil).

International collaboration.

THREAT

Lack of interest by the institutions that integrate the Technical Committee of AO.

Lack of financing of Ministry of Agriculture.

Not have an informatic specialist dedicated to the Observatory. Risk of sustainability because replace or substitution of managers/collaborators.

Other centers could giving the same information provided by AO.

Note: part of SWOT analysis made in order to continue improving the Agroclimatic Observatory (survey applied in august 2017).

AGROMET: NATIONAL AGROCLIMATIC NETWORK

CHARACTERISTICS

Developed by collaborative work between the Undersecretary of Agriculture and 4 public-private networks

Real-time information, online, and downloadable.

Free of barriers - information access (no cost, no password)

Stations distributed in all areas of agricultural importance, especially small-scale agriculture.

324 Authomatic Meteorological stations (AMS) that provide 7-parameter hourly information.

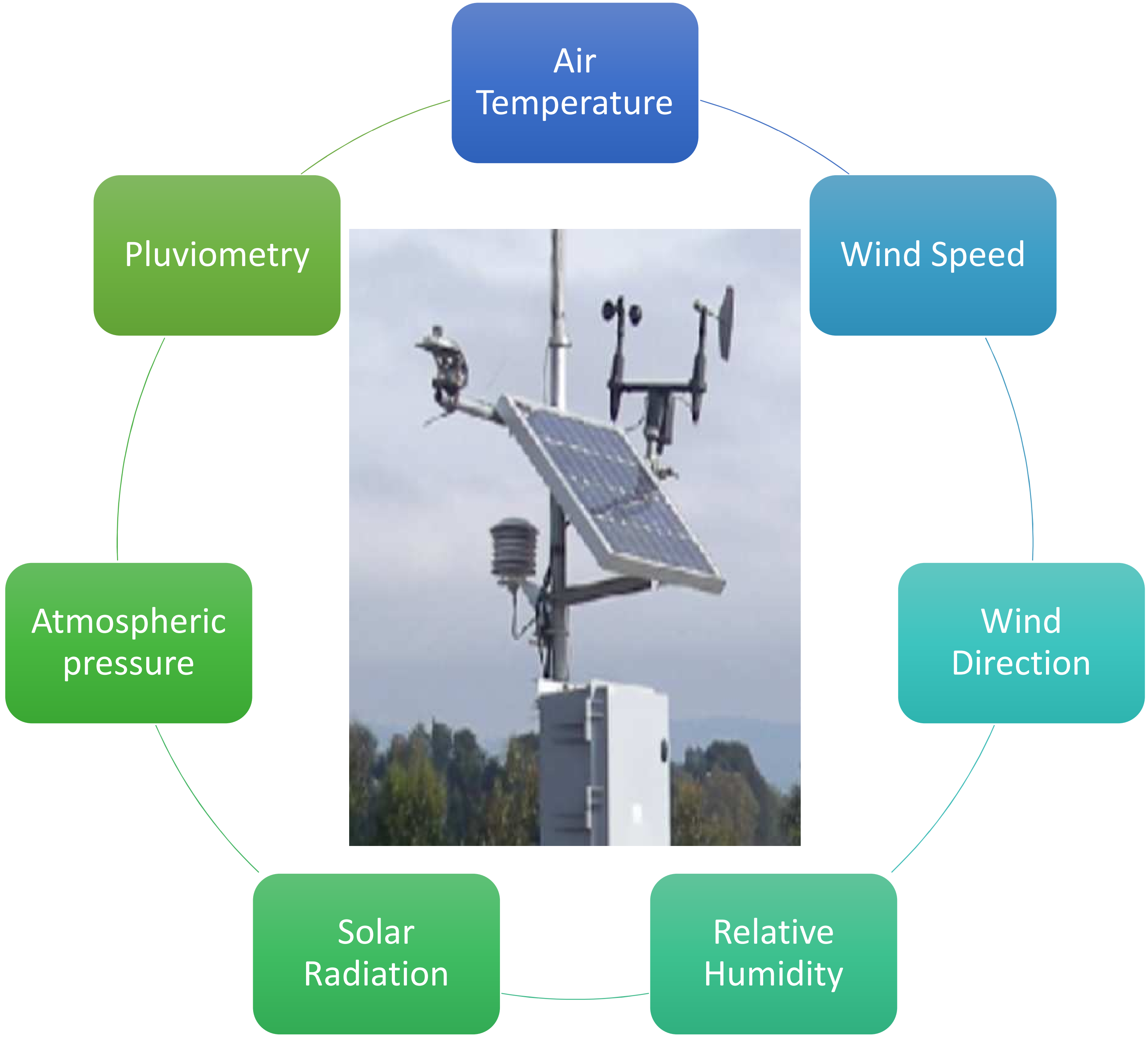
The Undersecretary sustains the network, hosts the database of the RAN and the Web portal www.agromet.cl

HOW IS THE NATIONAL AGROCLIMATIC NETWORK CONFORMED?

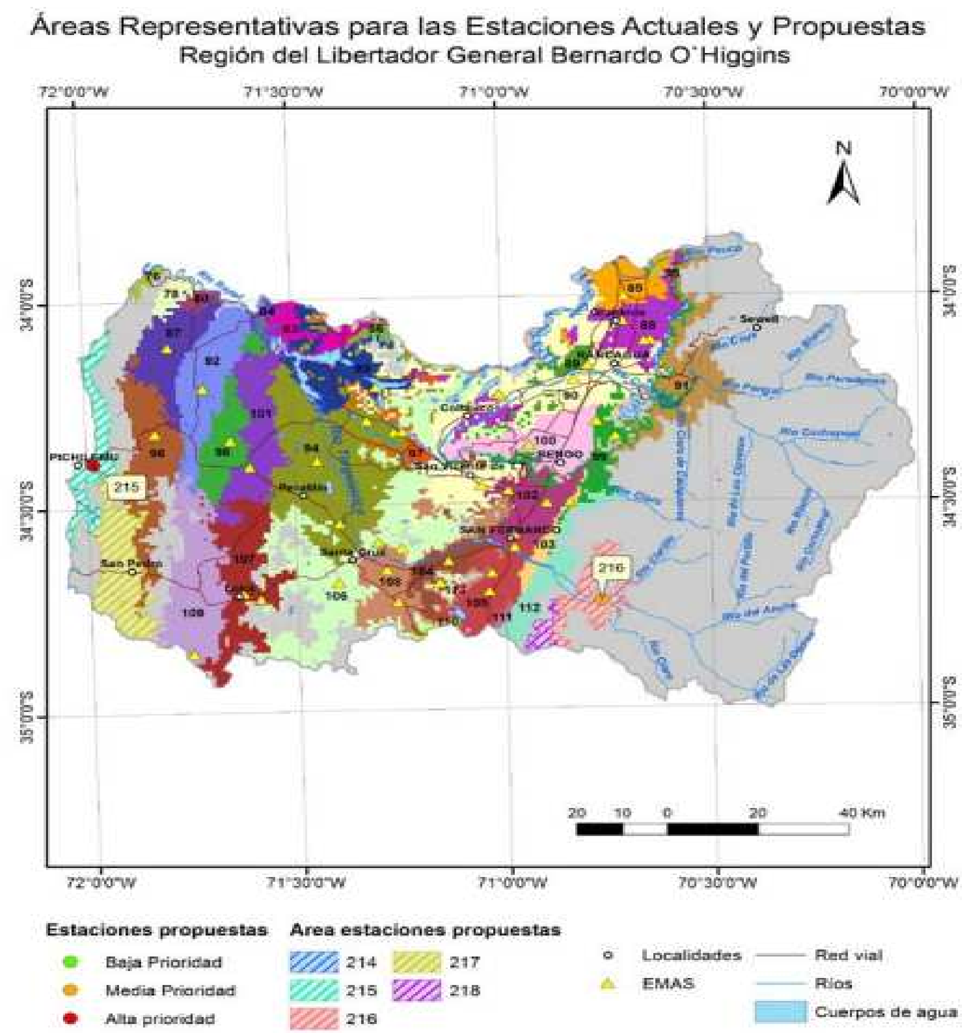
Technical Consortium CRAN

324 AMS Network

Real-time information, online, free and downloadable


Air Temperature
Wind Speed
Wind Direction
Relative Humidity
Solar Radiation
Atmospheric pressure
Pluviometry

AREAS OF COVERAGE OF AMS. O'HIGGINS REGION.

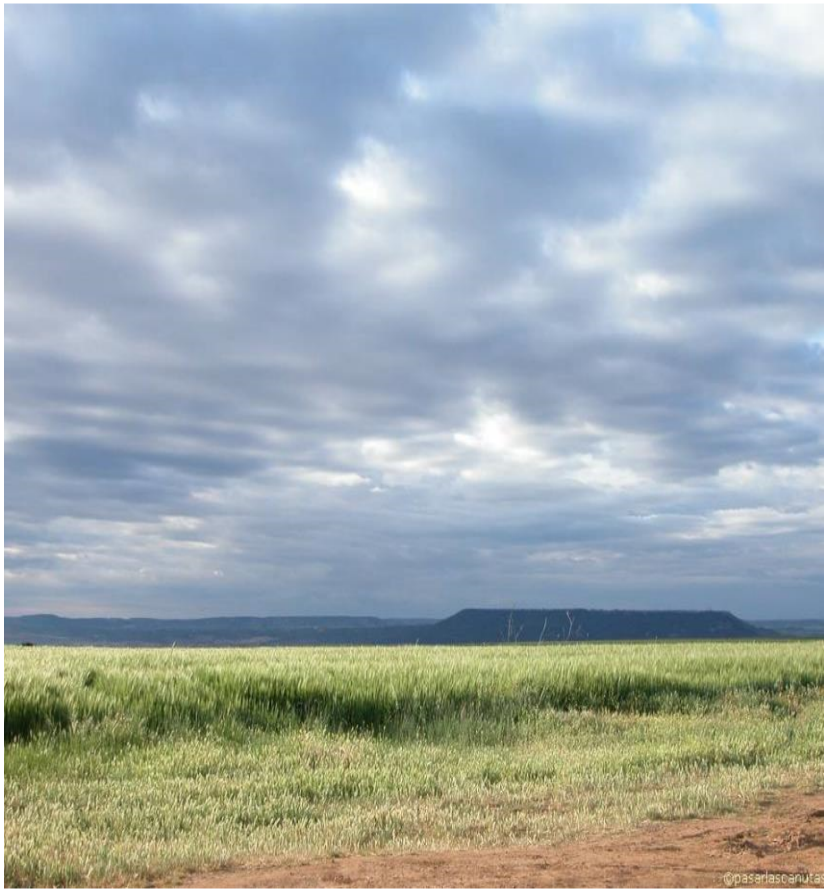


ADAPTATION FUND

ENHANCING RESILIENCE TO CLIMATE CHANGE OF THE SMALL AGRICULTURE IN THE CHILEAN REGION OF O'HIGGINS

COMPONENT 2

Sub Dep. of Information, Monitoring and Prevention
Ministry of Agriculture



PROJECT OBJECTIVES

MAIN OBJECTIVE

- ENHANCING THE RESILIENCE CAPACITY OF RURAL AGRICULTURAL COMMUNITIES IN THE COASTAL AND INLAND DRYLANDS OF THE O'HIGGINS REGION WITH RESPECT TO CLIMATE VARIABILITY AND CHANGE.

SPECIFIC OBJECTIVES

- Implement a system of capacity building and training to increase the resilience capacity of vulnerable communities to climate variability and change, regarding livestock, crops and soil and water management.
- Implement measures and technologies to increase the availability of water resources of rural communities in the coastal and inland dry sectors of the O'Higgins region.
- Improve decision making based on the management of agroclimatic information for the current climate variability and change, focused on local MINAGRI professionals and rural communities.

COMPONENT 2: PRODUCTS

PRODUCT 1
STRENGTHENING OF THE EXISTING NETWORK OF METEOROLOGICAL STATIONS and OTHER MONITORING SENSORS IN THE PROJECT AREA

PRODUCT 2
CREATION OF DATA ANALYSIS CAPABILITIES AND THEIR INTEGRATION IN MEANINGFUL DECISIONS FOR AGRICULTURAL MANAGEMENT

WORK PROPOSAL FOR BUILDING RESILIENCE OF MULTI-STAKEHOLDERS AND LOCAL COMMUNITIES

PRIORITY ISSUES AND ACTIVITIES

PRIORITY ISSUES

1. Improvement of Integrated Risk Management by building a Drought Policy. This policy will consider three pilars:
   - Monitoring, forecast and early warning system
   - Vulnerability and Resilience impact assessment
   - Mitigation and response plans and measures
2. Implementation of climate services to enhance the water resources management.
3. Building climatically resilient catchments to get better ecosystemic services
4. Pre-Drought Programme and Risk Reduction Actions (short term to long term initiatives).

CROSS-CUTTING ACTIVITIES

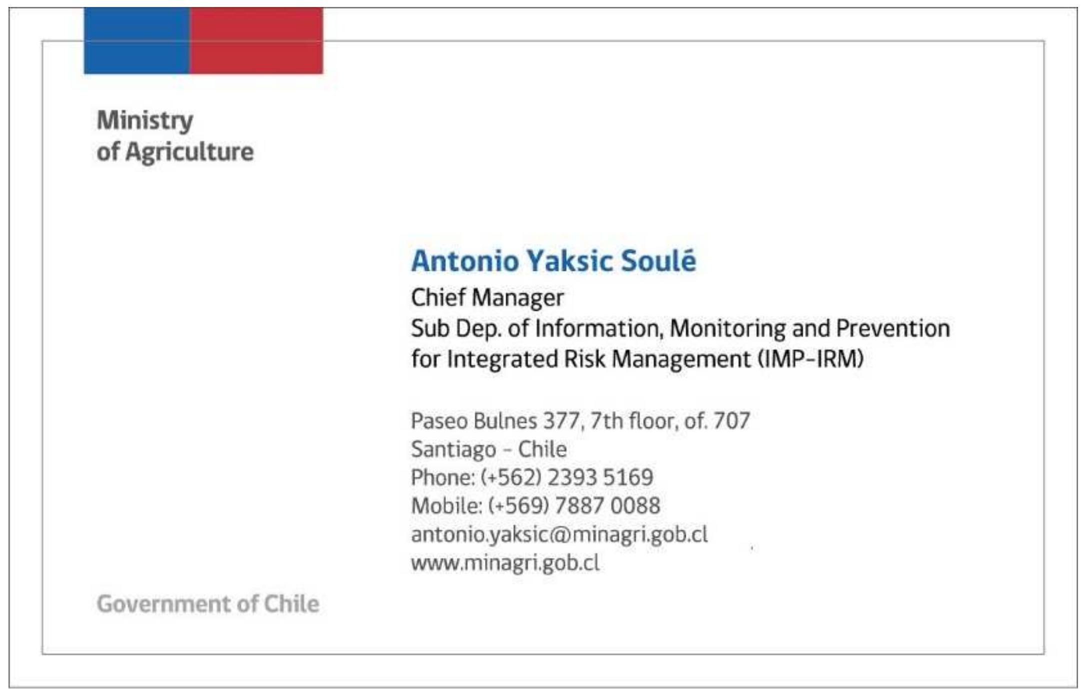
1. Strengthen of the community by using practices related to Rainfed/Dryland Management to sustain the development and implementation of IRM in the Region.

2. Training of multi-stakeholders to strength theirs resilience capacities to face climate hazards.

PRIORITY ACTIVITIES

1. Enhancing the Integrated Risk Management through a Preparedness Policy.
   - Agroclimatic Observatory as a tool for decision-makers (multi stakeholders):
     - Move towards an Adaptive governance
     - Outlook as an instance for analysis and reflection
     - Enphatize the Holistic approach
     - Recognition, validation and positioning.
2. Development and consolidation of preparedness policies and mitigation strategies (to add monitoring and preparedness). Training of muliples stakeholders.
   - e-learning courses with regional participation
3. Strengthening of the Community on management practices in dryland areas to sustain the development and implementation of CRM in the Region.
   - Broadcasting of Drought Management Tools for Dryland/Rainfed areas.
   - Regional Observatory for development and implementation of CRM in the Region.

THANKS…



Ministry
of Agriculture

Antonio Yaksic Soulé
Chief Manager
Sub Dep. of Information, Monitoring and Prevention
for Integrated Risk Management (IMP-IRM)

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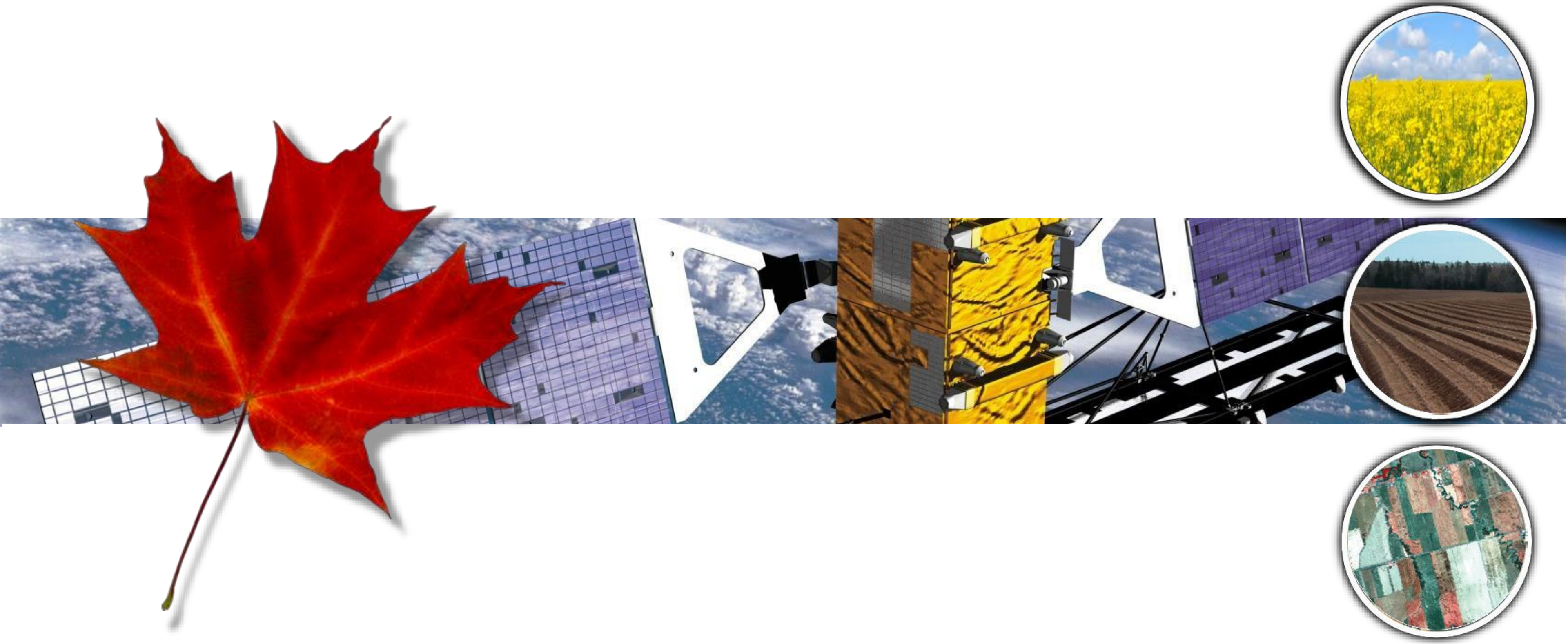
Government of Chile

Heather McNair, Research and Scientist Ottawa Research and Development Center, Agriculture and Agri-food, Canada. Presentation: A view from afar: Space technology aiding agriculture in a Changing climate

Agriculture and Agri-Food Canada	Agriculture et Agroalimentaire Canada



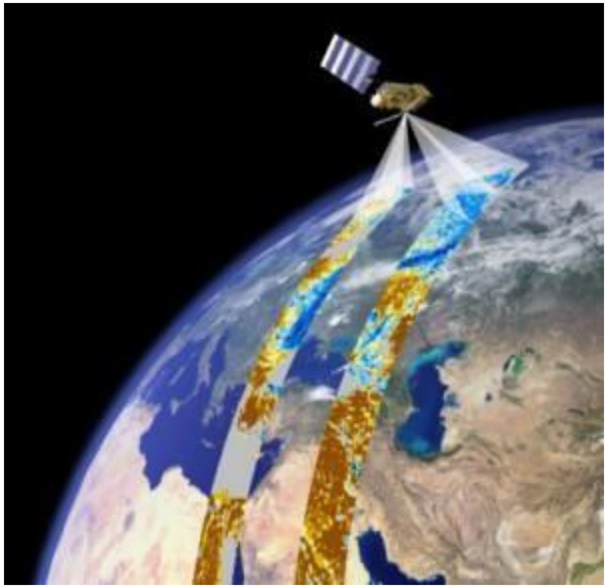
A View from Afar: Space Technology Aiding Agriculture in a Changing Climate

Heather McNairn[1], Dan MacDonald[1], Stanley Best [2] and Alyssa Whitcraft[3]

[1]Agriculture and Agri-Food Canada, [2]Instituto de Investigaciones Agropecuarias, [3]University of Maryland
heather.mcnairn@agr.gc.ca

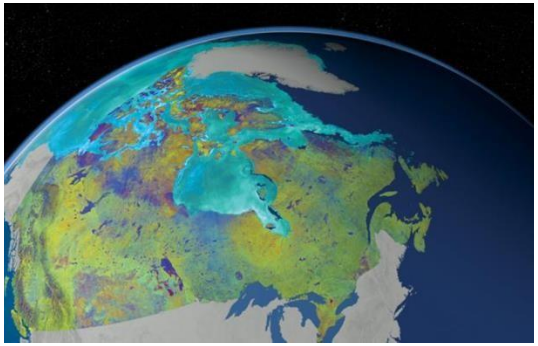
Outline

- Background on Earth Observation
- Monitoring from space
    - Changing cropping patterns
    - Risk assessment
    - Measuring impacts of beneficial practices
- Collaboration between Agriculture and Agri-Food Canada and Chile (Dr. Stanley Best, INIA)
- Multi-national initiatives
    - GEOGLAM (Group on Earth Observations Global Agricultural Monitoring Initiative)
    - AmeriGEOSS
- Summary



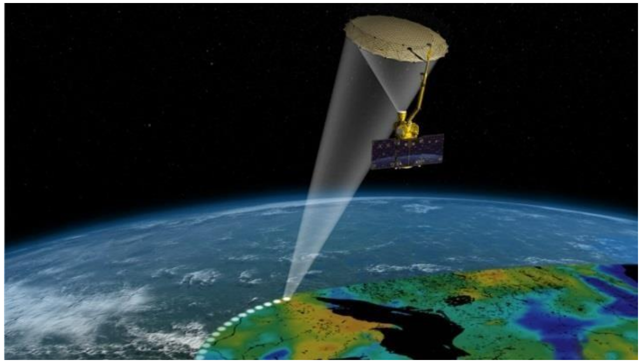
Impact of climate change on Canadian agriculture*

- most regions of Canada are projected to warm during the next 60 years, providing opportunities for agriculture in certain regions (expansion of growing season; milder & shorter winters; longer frost-free seasons)
- modeling indicates that for Canada, under a future climate (on average), high temperatures would increase by 2°C to 3°C & low temperatures increase by about 3°C
- when compared to the current climate, precipitation could increase by three to seven per cent
- however, prediction of increased intensity and frequency of droughts and violent storms, which would negatively affect crop yields
- increased vulnerability of producers to climate change, particularly in semi-arid regions of Canada
- potential impacts on crop pests and disease (increased range, frequency and severity of infestations)



* *www.agr.gc.ca/eng/science-and-innovation/agricultural-practices/agriculture-and-climate/future-outlook/impact-of-climate-change-on-canadian-agriculture/?id=1329321987305*

Can space help?



- At 158.7 million acres* of total farm (93.4 million in crops), boots on the ground can't reach every acre
  - On foot: average person walks ~ 3 miles/hour and at this rate it would take 5 years (10 hours per day) to walk across Canada
  - Satellites: orbit Earth at **~17,000 miles/hour**. Canada's RADARSAT satellite orbits the earth ~14 times in one day

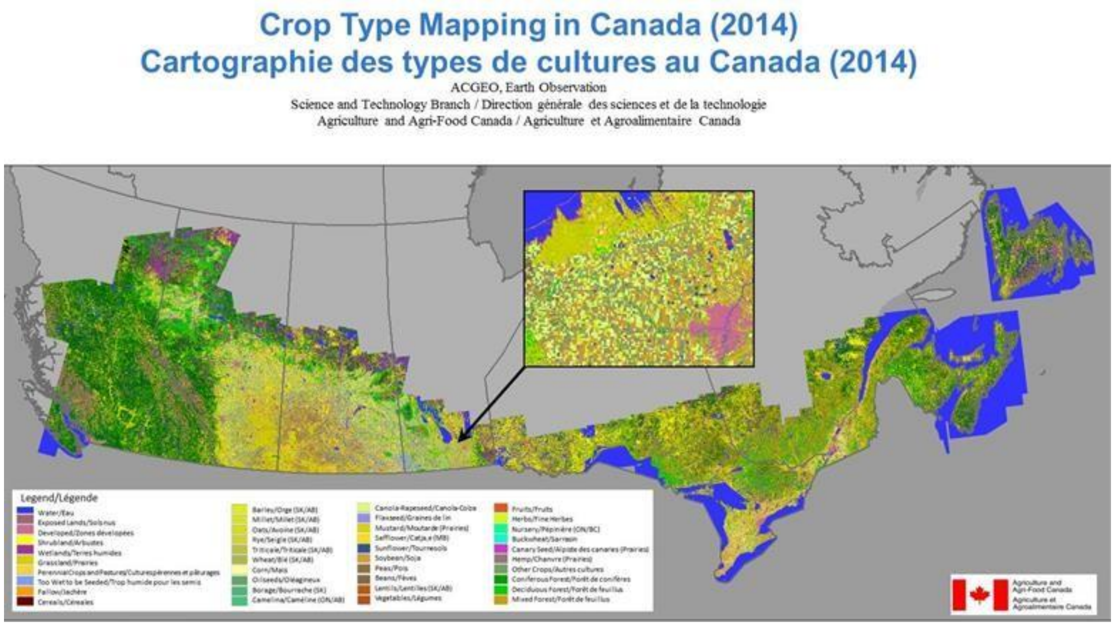
- Satellites collect measurements of the amount of energy **emitted, reflected or scattered,** and the intensity of energy depends on the type and condition of soils and crops

- **Potential contribution of monitoring from space**
  - Track where and how cropping practices are changing
  - Measure changes in crop production at regional, national and global scales
  - Monitor environmental factors that inform risk mitigation in short, medium and longer term
  - Measure soil and crop conditions to inform field level adaptations
  - Monitor up-take of best management practices

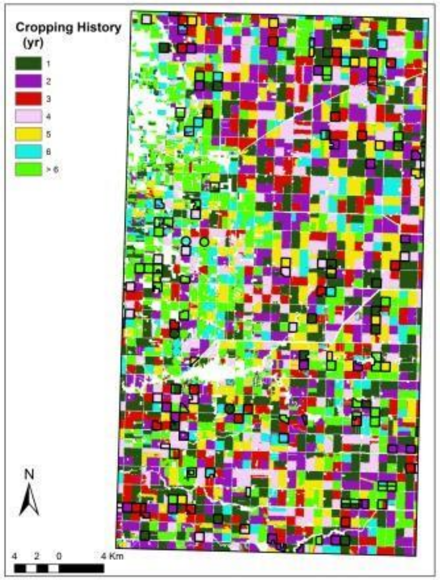
**2016 Census of Agriculture*

1. Monitor changing cropping patterns

- In 2004 Agriculture and Agri-Food Canada began development of a method to use satellite data to monitor crops
- The approach uses optical and radar satellites to identify what crop is grown in every field in Canada
- The annual crop inventory is now operational and has just completed its 7th year
- Data are available through the Government of Canada's open data portal and are being accessed by governments (federal, provincial, municipal), commodity groups, industry and academia



Contact: Dr. Andrew Davidson (Andrew.Davidson@agr.gc.ca)



Valued added product: field level cropping history for last 6 years

2. Risk: Flooding, excessive wetness, drought, pests, disease

Flooding, excessive wetness, drought, pests, disease

2017: April/May set new rainfall records in eastern Canada

2014: Excess moisture insurance payments to Manitoba farmers who were unable to seed **~$65 million** (2,400 claims)

2011-12: more than **$420 million** was spent by Agri-Recovery on climate related disasters mostly related to excess moisture.

2011*:* total costs from the 2011 Manitoba Flood topped **$1 billion** with over **$320 million** going to the agriculture sector in Crop Insurance and Agri-Recovery Programs***.***

2010: Sclerotinia cost western Canadian canola growers **$600 million** in lost revenue This disease is most severe in areas of high soil moisture.

<u>The common link: Not enough or too much soil moisture</u>

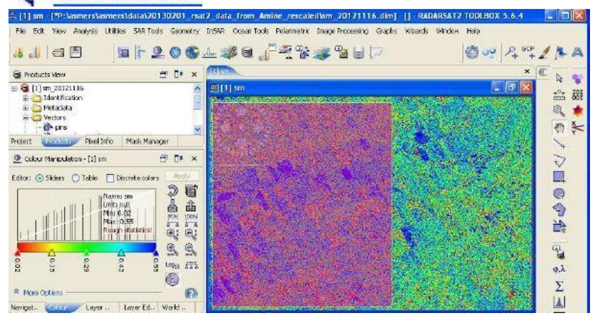
2. Monitor risk due to soil moisture extremes

Research Support by AAFC and Canadian Space Agency

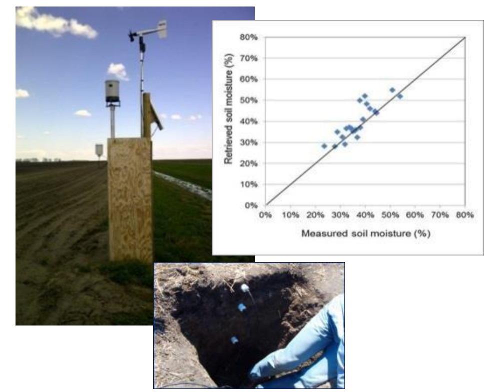
Data from Radar Satellites

Modeling developed by AAFC and implemented in industry software

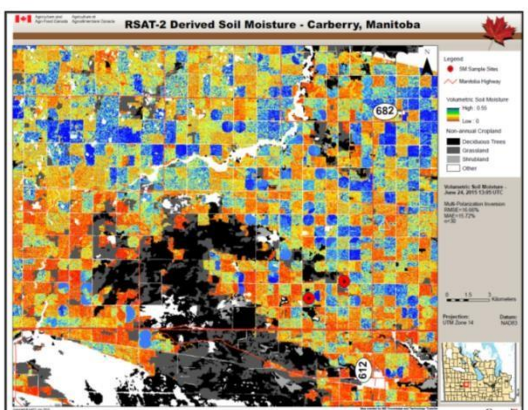
SNAP Toolbox



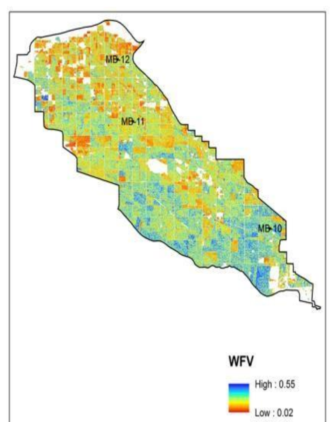
Validate with AAFC Real-time In-situ Soil Monitoring for Agriculture (RISMA)

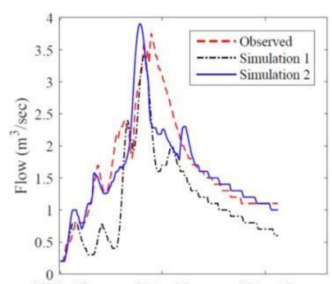


Maps of surface soil moisture



Down stream applications: integrate satellite-based soil moisture in hydrological models

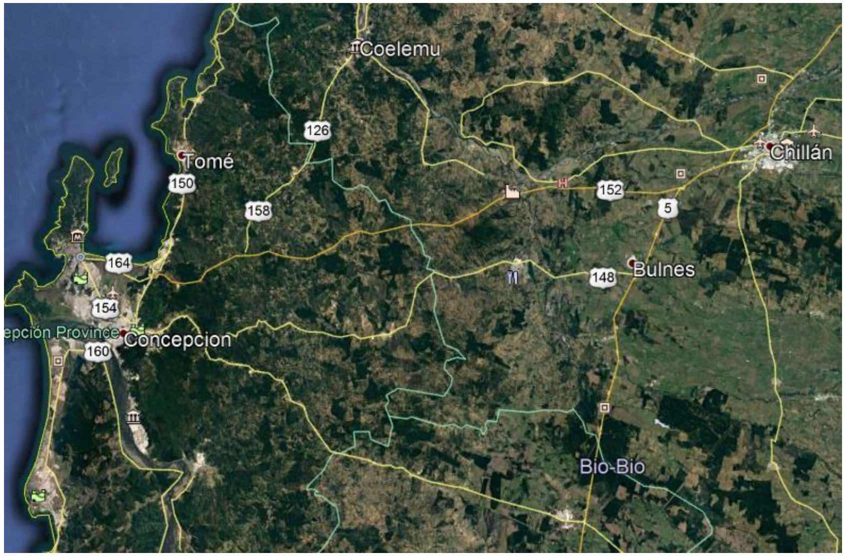




Impact: improved stream flow forecast for flood risk assessment

2. Satellites to inform water use in Chile

Orafti research sites south of Chillan (Chile)

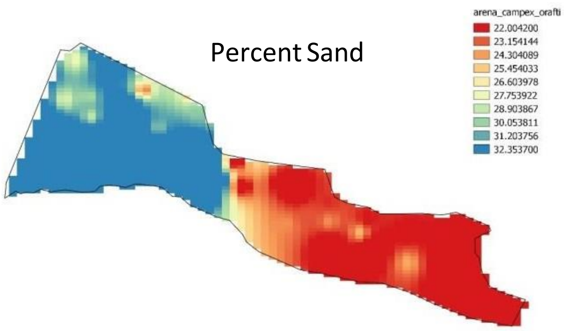


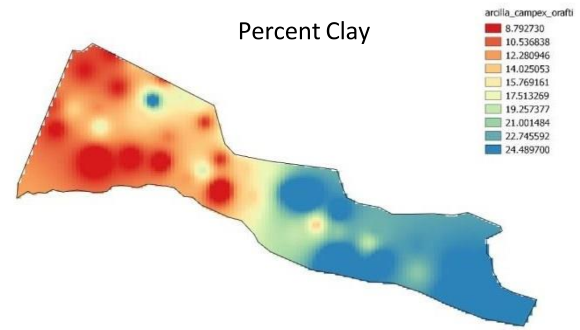
Chicory Seedlings

Irrigation scheduling: when, where and how much

2. Temporal monitoring of soil moisture: Chile

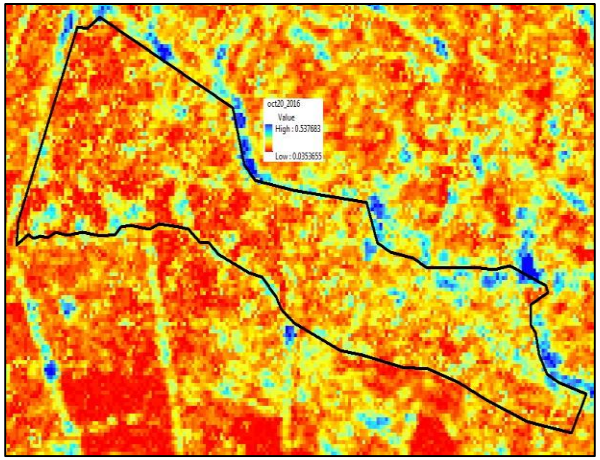
Variances in soil texture



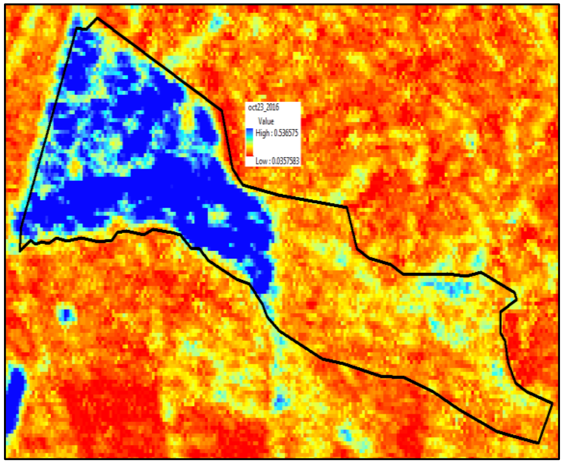


Maps of percent soil moisture from RADARSAT-2 (wet=blue)
Orafti Site: October 20 to December 31, 2016

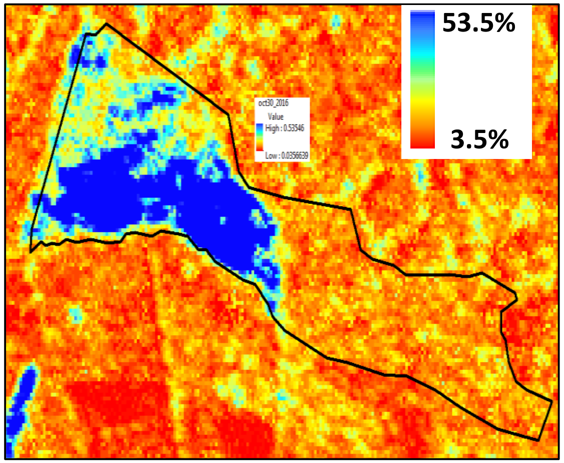
October 20th



October23rd

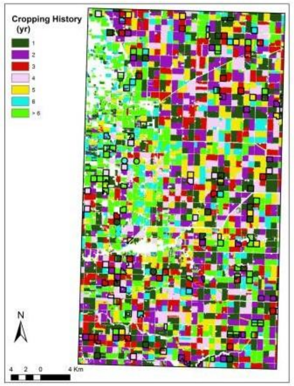


October 30th

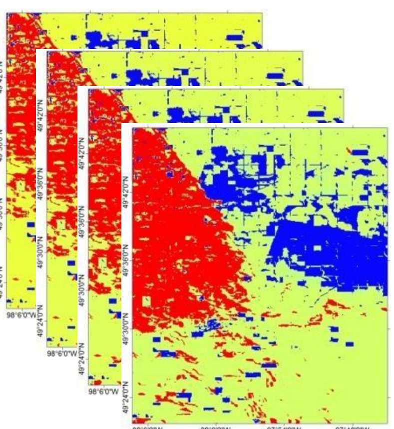


2. Monitor crop disease risk: Sclerotinia Risk Tool (SRT)

Number of years since last canola crop (updated annually)

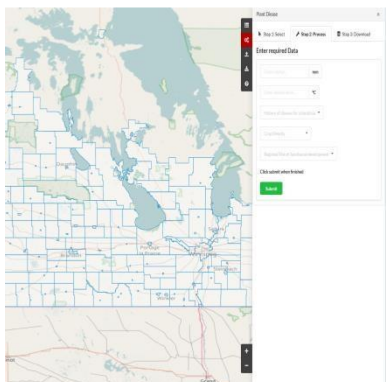


Wetness persistence (excess soil moisture updated every 6 hours)



Integrated “web-based” risk assessment tool

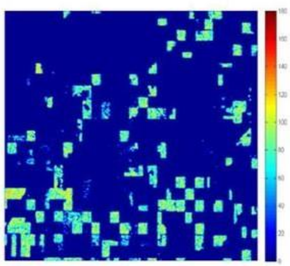
Digital Dash Board (High, Medium, Low)



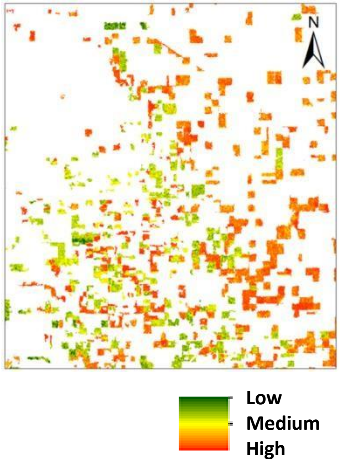
User inputs
- Crop density
- History of disease in field
- Regional risk of disease

2010: Sclerotinia cost western Canadian canola growers **$600 million** in lost revenue This disease is most severe in areas of high soil moisture.

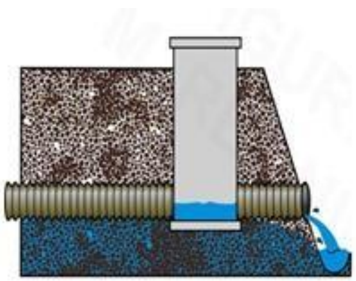
satellite-based canola staging
- begin flowering
- < 50% flowering
- > 50% flowering

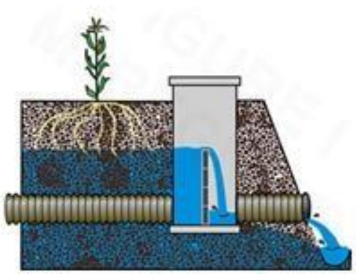


Output
- 100 m resolution map
- pixels flagged as at risk



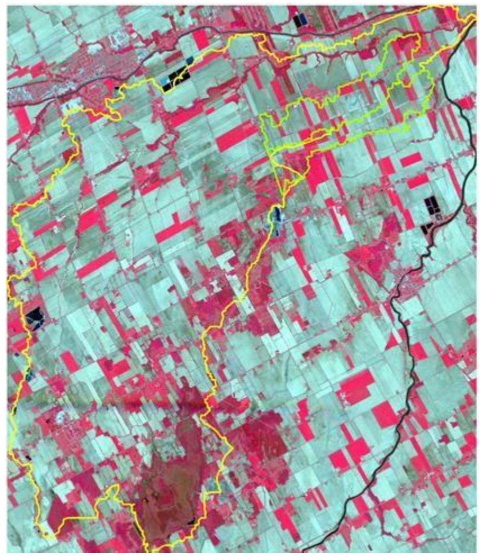
3. Measure benefits of best management practices: Impact on crop productivity



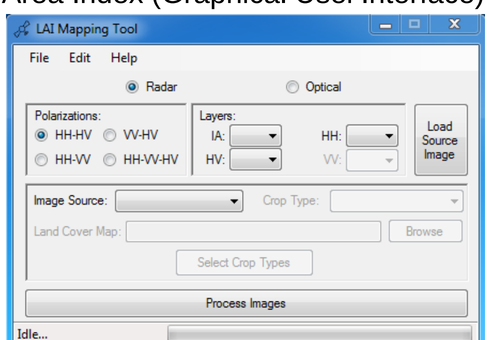


Contact: Dr. David Lapen (David.Lapen@agr.gc.ca)

Watershed-scale production monitoring



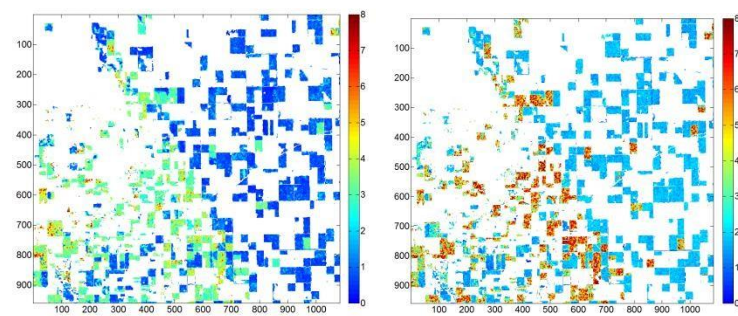
AAFC models for biomass or Leaf Area Index (Graphical User Interface)



Biomass of corn and soybeans from optical satellites

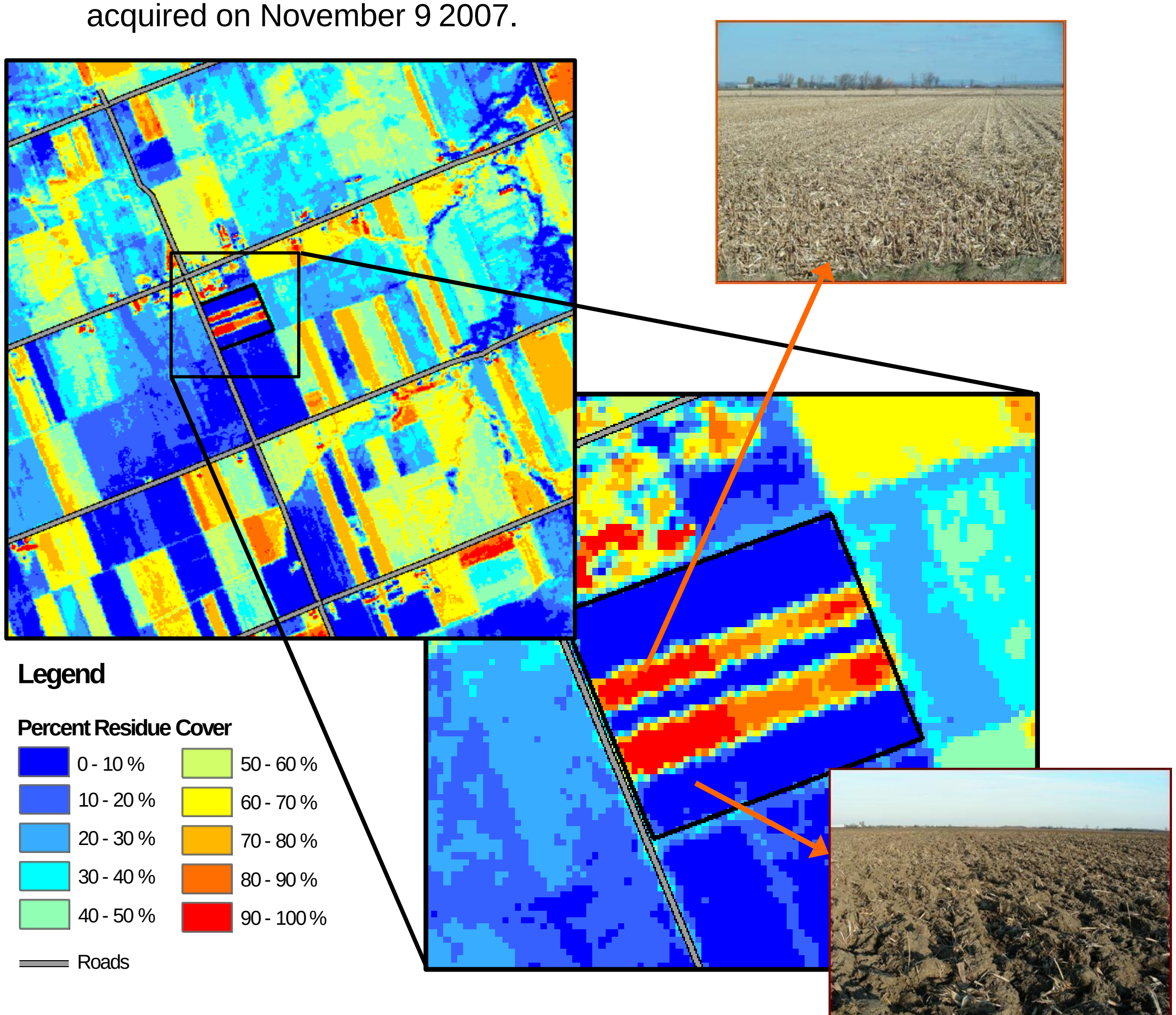
2012 (very dry year) 2013 (very wet year)

Biomass of corn, soybeans and wheat from radar satellites

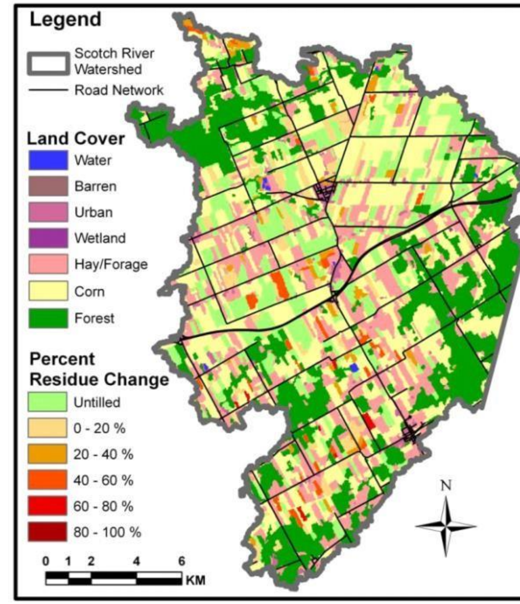


3. Measure benefits of best management practices: Soil management

Residue cover product derived from Spot-5 acquired on November 9 2007.



Change in residue due to tillage events



Food Security & Sustainable Agriculture GEOGLAM Latinoamérica

- GEO (Group on Earth Observations) formed in 2003 and is a partnership of >100 national governments & 100 Participating Organizations that coordinates Earth observations to assist in informing decisions and actions for the 8 Societal Benefit Areas

- **GEOGLAM*** (GEO Global Agricultural Monitoring Initiative) launched by the Group of Twenty (G20) Agriculture Ministers in 2011
- G20 Ministerial Declaration states that **GEOGLAM "will strengthen global agricultural monitoring by improving the use of remote sensing tools for crop production projections and weather forecasting“**

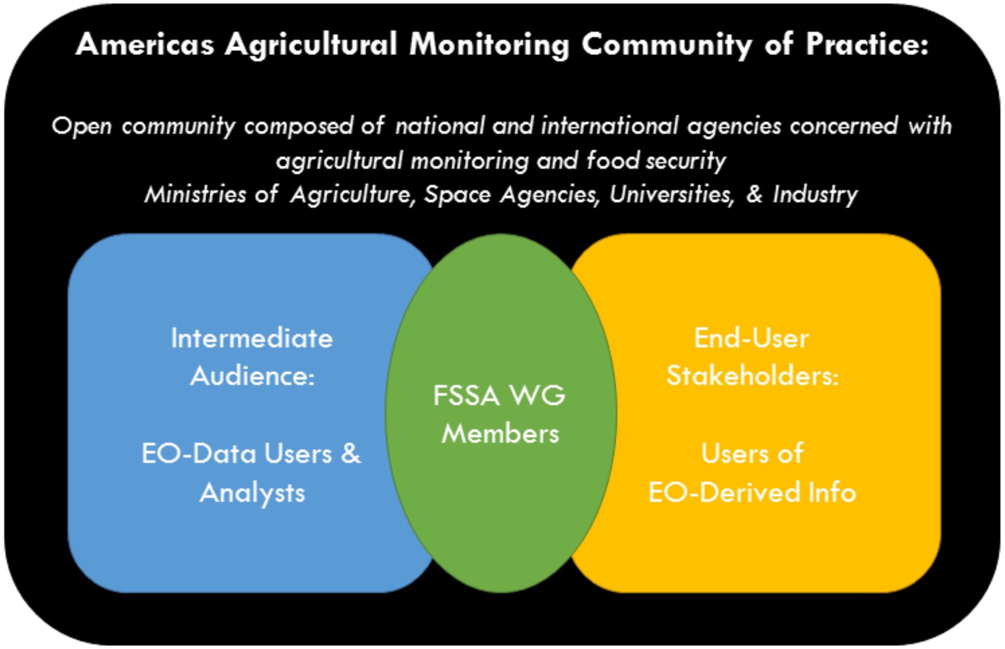
- AmeriGEOSS* initiative is a framework to promote collaboration and coordination among the GEO members in the Americas

- Goals:
  – Regional Coordination
  – National Capacity Development
  – Exchange of experiences
  – Lateral Transfer of Technology and Methods

*www.earthobservations.org/geoglam.php and www.amerigeoss.org/index_html

Food Security & Sustainable Agriculture (FSSA) Working Group (WG) Status and Updates

- Funding secured to focus on community building for the FSSA WG
- Building community of practice = initial focus
  - Satellite-data users/analysts
  - Stakeholders
  - End users
  - *Seeking participation and co-leadership from other Americas caucus countries*
  - *Will lean on existing GEOGLAM Latinoamérica "Agricultural CoP"*



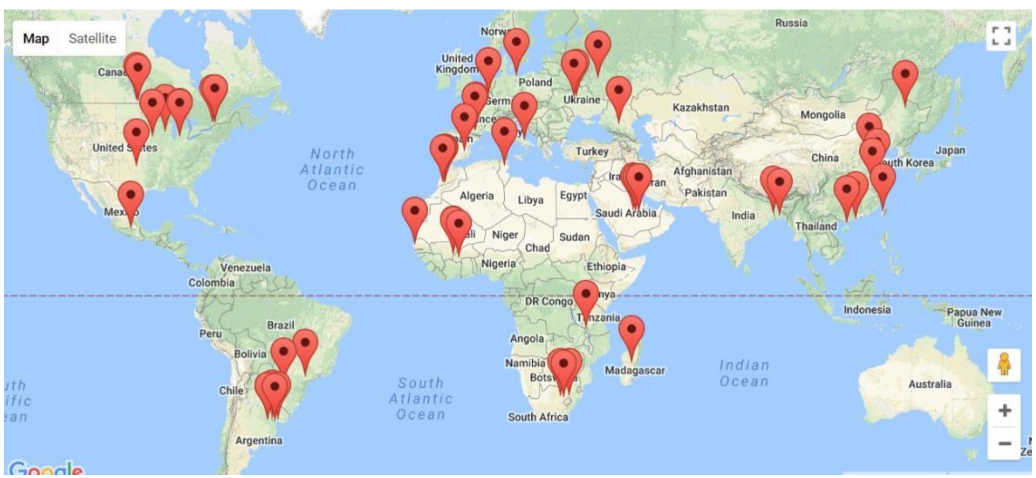
- Current leadership of G-LA = Carlos di Bella, INTA Argentina
- Current leadership of FSSA = Alyssa Whitcraft, UMD/GEOGLAM

Food Security & Sustainable Agriculture WG and GEOGLAM-LA Plans for 2018

- G20 and Agricultural Market Information System chairmanship = Argentina
  - workshops and events to showcase agriculture monitoring (planning stages)
- Committee on Earth Observation Satellites (CEOS) Working Group (WG) on Capacity Development and AmeriGEOSS meetings in Brazil provide opportunities for training course and materials development, side events for WG community growth
- Linking existing activities and actors into WG
  - e.g. Crop mask generation in Argentina (BAGE); GLAM in Argentina (INTA) and Brazil (CONAB); soybean mapping in Americas (Hansen, UMD); JECAM site & RAPP pilot sites in the Americas; GLAM system for Chile (planned)
- Support UN Sustainable Development Goals – especially Goal 2: Zero Hunger
- Build AmeriGEOSS FSSA WG participation alongside GEOGLAM Latinoamérica
- Define FSSA WG goals & milestones (including national surveys & stakeholder assessments)
- Coordinate with other international & national capacity development activities

- Contact: Dr. Alyssa Whitcraft (alyssakw@umd.edu)

Joint Experiment for Crop Assessment and Monitoring (JECAM)



NEWSLETTER Vol. 4 October 2017

SAR INTER-COMPARISON EXPERIMENT

Component 1, Activities 1a, 1b & 2, and Component 2, Activity1 are closed OCTOBER 15th 2017! We will send a new Participation Form in January 2018 for interest in Activity 2 for both Components! Thank you for your interest!

Presentation at SPIE 2017

(From left: Medhi Hosseini, AAFC, and Katarzyna Dabrowska-Zielinska, Poland.)

Medhi Hosseini presented his work on the Water-Cloud Model at SPIE 2017 in Warsaw, Poland. While he was there he met with the JECAM Poland lead Katarzyna Dabrowska-Zielinska, head of the Remote Sensing Center, Institute of Geodesy and Cartography, Poland.

EVENTS

Past	Upcoming
August 3, 2017 LAI & Biomass Webinar #2	**December 2017** JECAM site visits
September 2017 SPIE Remote Sensing Warsaw, Poland Mehdi Presented	**December 2017** AGU 2017, New Orleans Laura attending
	January 2018 1st Annual Report to CSA and JECAM Partners

PARTICIPANTS

Component 1, Activities 1a, 1b & 2,

Argentina, Belgium, Brazil –Tocantins, Canada, France, India, Italy, Poland, Ukraine, USA-Georgia, USA-Iowa and USA-North Dakota!

Component 2, Activity 1

Canada, India, Italy, Poland, Taiwan, Ukraine, USA-Georgia, USA-Iowa and USA-North Dakota!

EXPERIMENT PROCESSING

EO Data Processing: We are re-processing the Sentinel 1, Landsat 8, Sentinel 2 and Radarsat-2 data for those files that failed our QC phase.

Field Data Processing: We continue to refine the field data received from the partners to create the most consistent *in situ* data sets possible.

LAI & Biomass Model Testing Update

We will be testing 4 LAI and Biomass models utilizing the data that has been uploaded, and the EO data that has been acquired and pre-processed.

3 variations of the Water -Cloud Model

Canada
Hosseini, M., McNairn, H., Merzouki, A., and Pacheco, A. (2015). "Estimation of Leaf Area Index (LAI) in corn and soybeans using multi-polarization C- and L-band radar data.", *Remote Sensing of Environment, 170*, pp. 77-89.

Belgium
Beriaux E., Lambot S., and Defourny P. (2011), "Estimating surface-soil moisture for retrieving maize leaf-area index from SAR data.", Can. J. Remote Sensing, 37, pp. 136-150.

Poland
Dabrowska-Zielinska K., Inoue Y., Kowalik W., Gruszczynska M. (2007). "Inferring the effect of plant and soil variables on C- and L-band SAR backscatter over agriculture fields based on model analysis.", Advances in Space Research, 39, pp. 139-148

Italy
Method: Band Ratios

CONTACTS: LAURA.DINGLE-ROBERTSON@AGR.GC.CA MEHDI.HOSSEINI@CARLETON.CA

JECAM Joint Experiment for Crop Assessment and Monitoring

GROUP ON EARTH OBSERVATIONS

To be part of the JECAM team contact Dr. Heather McNairn (heather.mcnairn@agr.gc.ca)

Summary

- Satellites acquire “raw” data over hundreds of kilometres, repeatedly

- Space data can support (among other things)
  - Tracking of changing cropping patterns
  - Monitoring environmental risks
  - Measuring impacts of beneficial practices

- Significant growth:
  - available data (open access)
  - engineering technology (advanced space assets)
  - research method development
  - operational implementation

- Opportunities to work together as a community (i.e. GEOGLAM, AmeriGEOSS and others) to further develop and transition to improve systematic monitoring to assist global agriculture

Team

- Agriculture Canada : Heather McNairn, Amine Merzouki, Xianfeng Jiao, Kiana Zolfaghari, David Lapen (and team), Anna Pacheco, Patrick Rollin, Xiaoyuan Geng, Andrew Davidson, Laura Dingle-Roberston, Jarrett Powers, Matthew Friesen, Kurt Gottfried, Jacqueline Freeman, Hassan Bhuiyan, Erle Einarsson, Alison Nelson, Evan Derdall

- Environment and Climate Change Canada: Stephane Belair, Leqiang Sun, Mohammed Dabboor, Marco Carrera, Erica Tetlock

- Canadian Space Agency

- Canadian universities: Ottawa, Carleton, Guelph, Manitoba, Concordia, Laval, Sherbrooke

- Industry: Array Systems, AUG Signals, Skaha Sensing

- International: NASA, USDA, 11 American universities, 20+ international collaborators (GEO-JECAM), research institutes in Italy, India, the Netherlands and Chile, international space agencies (Europe, Germany, Japan)

Jaime Flores, Formulation *Inter-American Institute for Cooperation on Agriculture (IICA), Chile.* Presentation: IICA experience on the capacity development of mitigation and adaptation against climate change

IICA experience on the capacity development to mitigate and adapt to climate change

Jaime Flores Ponce
IICA Representative in Chile
Katia Marzall,
Leader Resilience and Comprehensive Risk Management in Agriculture
Contacts: Jaime.flores@iica.int/katia.marzall@iica.int
http://www.iica.int

Outline:

- What is IICA?
  - IICA
  - The agriculture we promote
  - Countries' strategies and technical cooperation
- Resilience and Comprehensive Risk Management
  - Overall objective
  - Some strategies and methodologies
  - Some hemispheric, regional and countries results
  - Chile experience

IICA

The Inter-American Institute for Cooperation on Agriculture

Founded in 1942, IICA is the inter-American system's organization specializing in the agricultural sector and rural territories. As such, it stimulates, promotes, and supports the 34 member States' efforts to achieve sustainable development of agriculture and to enable rural communities to prosper.

Organization of American States | More rights for more people

IICA

The agriculture we promote

Strategic Objectives

The challenges for Agriculture:

Productivity and competitiveness, sustainability, inclusion, and food and nutritional security

Improve agriculture productivity and competitiveness

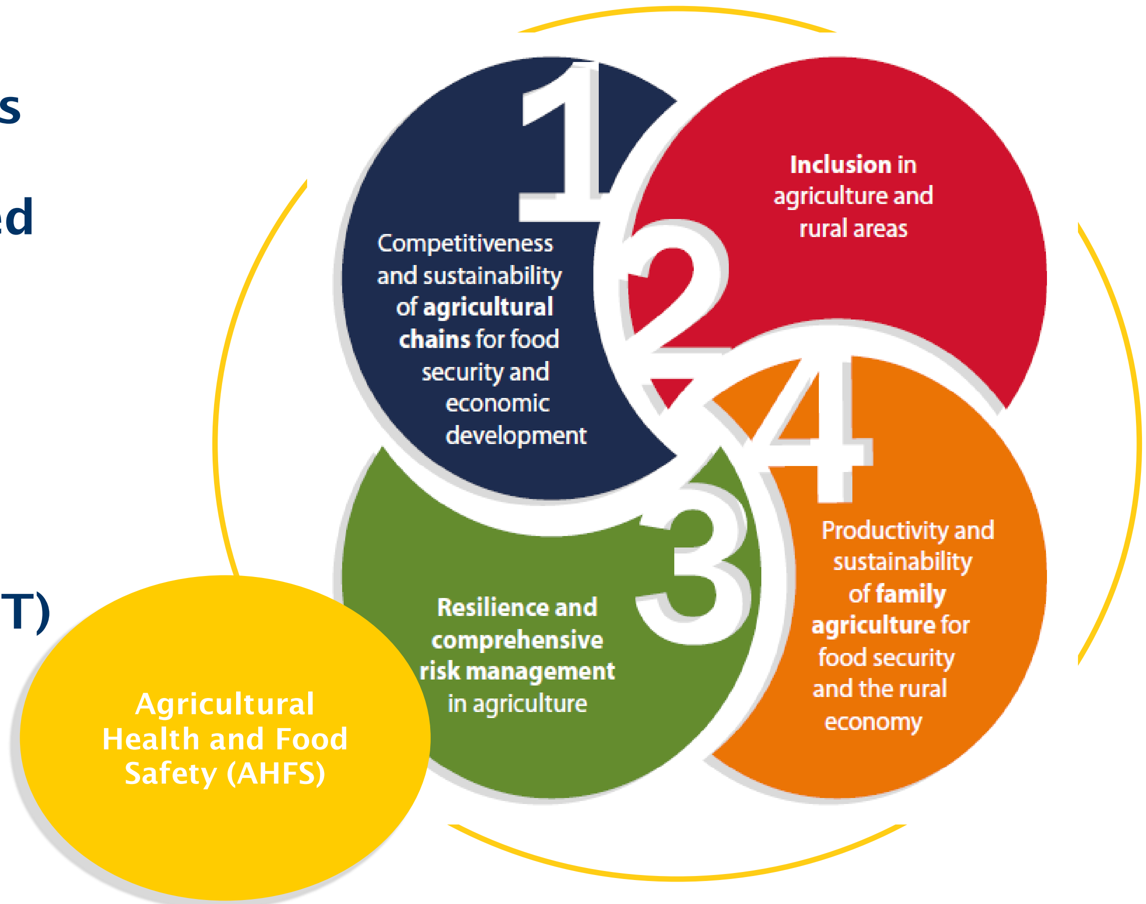
Strengthen agriculture’s contribution to rural development and well-being

Improve agriculture’s capacity to mitigate and adapt to climate change, as well as make better use of natural resources

Improve agriculture´s contribution to food security

Countries’ Strategies & Technical Cooperation

- Flagship Projects
- Externally funded projects
- Rapid Response Actions
- Pre-investment initiatives (FonCT)



Resilience and Comprehensive Risk Management

Overall Objective

To increase resilience of agricultural systems in the member countries in order to address the multiple risks posed by climate change, by strengthening the institutional framework for innovation and risk management based on the principles of sustainable adaptation.

IICA

Implementation strategy

- **Partnerships** and collaborations
- **Capacity Development**: Improved capacity for implementing good practices
- **Knowledge management**: managing and sharing information, methodologies and tolls
- **National Capacities**: Supporting the formulation of policies and development strategies

4 Components:

1. Resilient Production Systems
2. Environmental & Market Risks
3. Sanitary and Phytosanitary Risks
4. Water and Soil Management

Partnerships

IICA

JRC European Commission

EUROCLIMA

Comisión Europea

cooperación alemana

giz

Organization of American States | More rights for more people

CARICOM Caribbean Community — A Community for All

CAC — Consejo Agropecuario Centroamericano

CAS — Consejo Agropecuario del Sur

USDA

Agriculture and Agri-Food Canada

PNUMA

Naciones Unidas CEPAL

FAO

UNEP

THE WORLD BANK

IDB Inter-American Development Bank

PRICA-ADO
Programa Intergubernamental de Cooperación Cambio Climático
Oportunidades y Desafíos en la Agricultura

PROTERRITORIOS
PROGRAMA IBEROAMERICANO DE COOPERACIÓN EN GESTIÓN TERRITORIAL
PROGRAMA IBEROAMERICANO DE COOPERAÇÃO EM GESTÃO TERRITORIAL

FONTAGRO

World Resources Institute

Global Research Alliance on Agricultural Greenhouse Gases

CIMMYT

CATIE
Solutions for environment and development
Soluciones para el ambiente y desarrollo

LEDS LAC

AQUEDUCT Measuring and Mapping Water Risk

CIAT

PROMECAFE

inifap

CGIAR

Research Program on Climate Change, Agriculture and Food Security

CCAFS

PROCITROPICOS
Programa Cooperativo de Investigación, Desarrollo e Innovación Agrícola para los Trópicos Suramericanos

Corpoica

INIAP

CELOS

INIA

REGATTA

PNUMA

PROCISUR ONLINE

INTA ARGENTINA

INIAF BOLIVIA

Embrapa BRASIL

CHILE

IPTA PARAGUAY

INIA URUGUAY

IICA

Capacity Development

Presential training

Strategic tolls for governmental officers
Agricultural Risk Maps

Technical issues for field agents and farmers

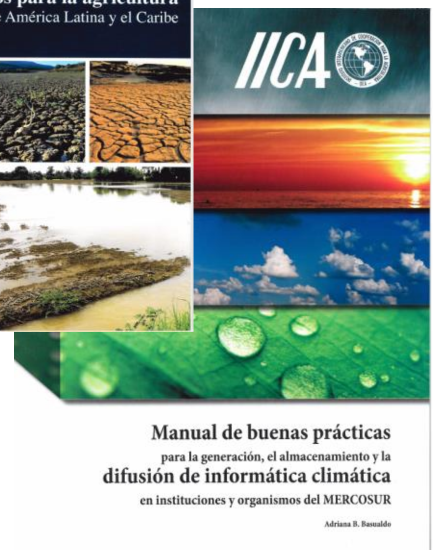
Distance training

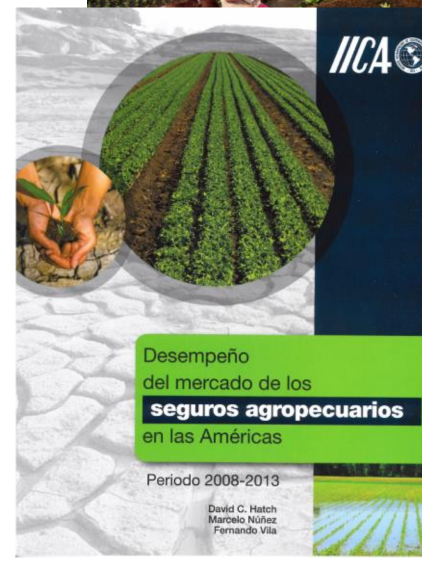
Diverse public, wide range, permanent Access, lower costs

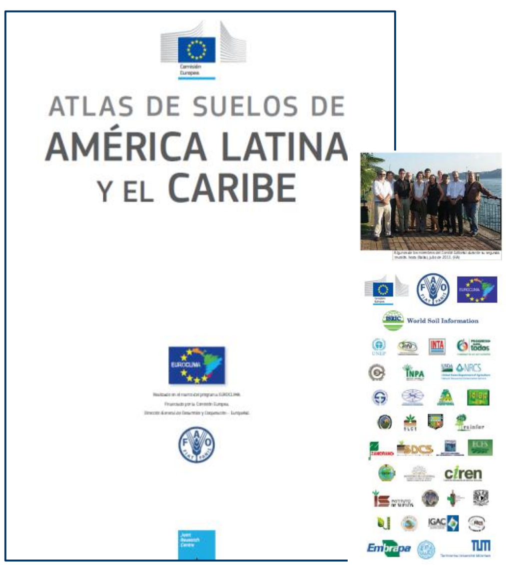
Knowledge Management Activities

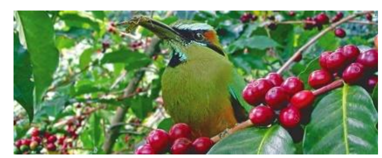
- Studies, methodologies, tolls developed or supported by IICA
- Support validation and/or adaptation of technologies, methodologies tolls developed by partner agencies
- Facilitated access to information

Cooperation Projects to Strengthen Technical Capacities





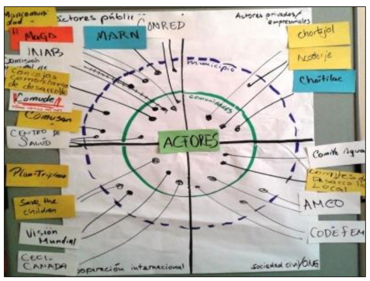




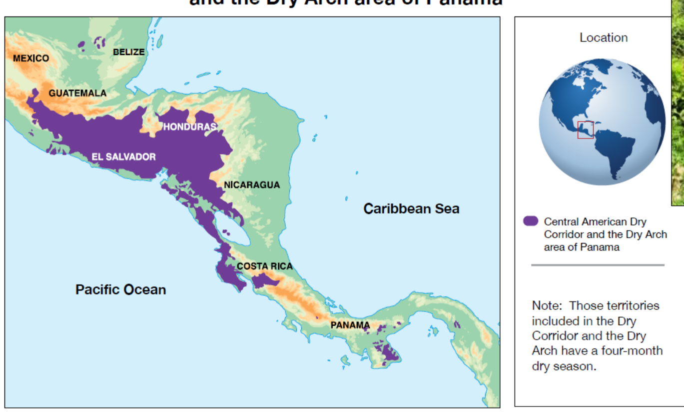
Sistema Regional de Alerta Temprana para la Roya y otras Plagas y Enfermedades Importantes del Café (SRAT)

Technical Cooperation Projects to Strengthen National Capacities

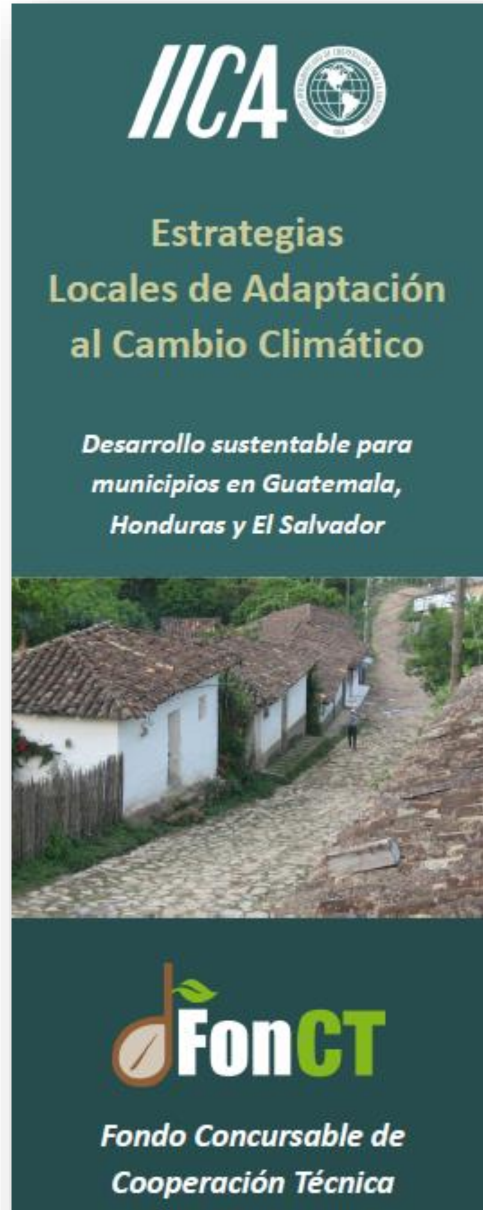
Participation in the inter-institutional thematic group of the Central American Dry Corridor to support the implementation of ECADERT



Location of the Central American Dry Corridor and the Dry Arch area of Panama



Source: Based on the Central American Atlas for Sustainable Territorial Management.



Plan Trifinio
"Agua sin fronteras"
El Salvador • Guatemala • Honduras

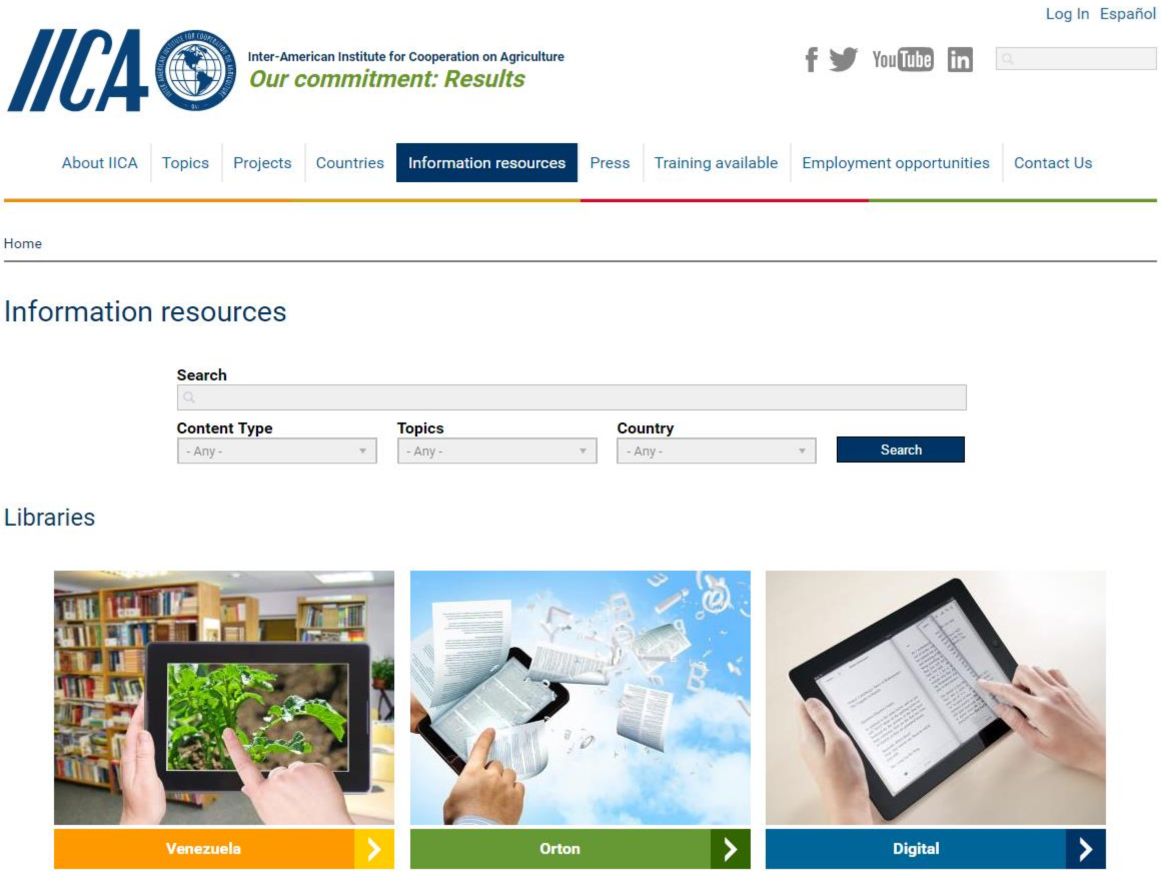
IICA

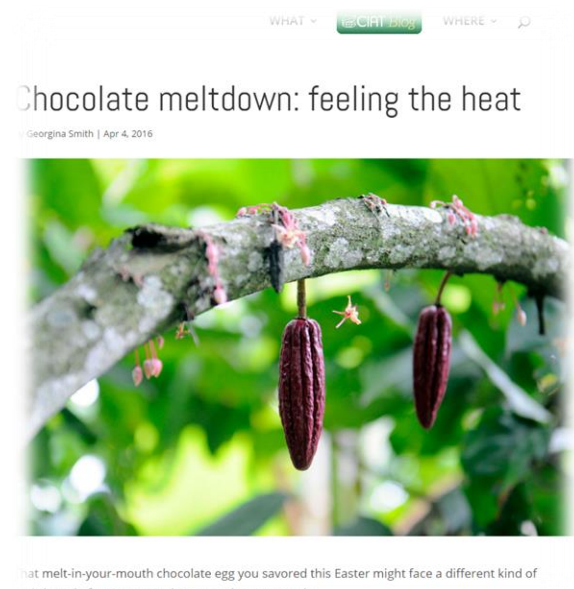
Discussion and validation of knowledge

Organization and Systematization of Technical Forums

Field experiments and pilot projects

Facilitated access





Facilitated access

Facilitated access

Technologies

Communities of Practice

COMUNIDAD DE PRÁCTICA
Adaptación y Agricultura en Mesoamérica

Caribbean Climate Smart Agriculture FORUM

IICA

National Capacities

Strengthening Capacities to Develop NAMAs

KEY POLICIES Strategies for risk management

Training of Trainers Courses "Ingegrating Climate Change Adaptation into Development Planning" PLANNING METHODOLOGIES


Gobierno de Chile
PLAN DE ADAPTACIÓN AL CAMBIO CLIMÁTICO DEL SECTOR SILVOAGROPECUARIO
cooperación alemana
DEUTSCHE ZUSAMMENARBEIT
Tercera Comunicación Nacional sobre Cambio Climático
Chile

IICA


IICA
CAMBIÓ EL CLIMA
Herramientas para abordar la adaptación al cambio climático desde la extensión

IICA


Integrando la adaptación al cambio climá-tico en la planificación del desarrollo
Una capacitación práctica basada en la Guía sobre Políticas de la OCDE
Manual de Capacitación
giz
Ministerio Federal de Cooperación Económica y Desarrollo
Integrando la adaptación al cambio climático en la planificación del desarrollo
Una capacitación práctica basada en la Guía sobre Políticas de la OCDE
Folletos
giz
Integrando la adaptación al cambio climático en la planificación del desarrollo
Una capacitación práctica basada en la Guía sobre Políticas de la OCDE
Guía para Instructores
giz

¿Course content?

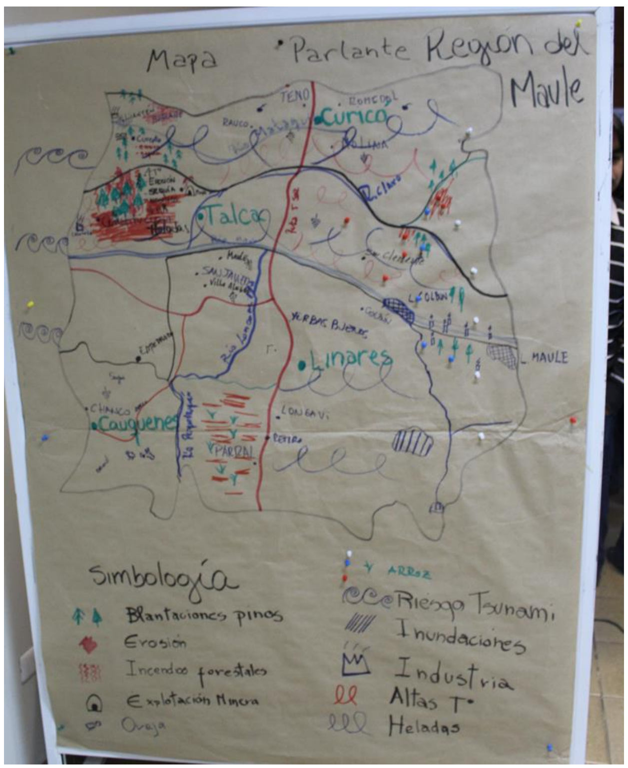
Módulos

- **M 1– Aplicar los “lentes climáticos”**
- **M 2– Interpretar los datos climáticos**
- **M 3– Evaluar la vulnerabilidad**
- **M 4– Identificar las opciones de adaptación**
- **M 5– Seleccionar las medidas de adaptación**
- **M 6– Desarrollar marco de Monitoreo y Evaluación**
- **M 7– Construir capacidades institucionales**
- **M 8– Tomar acción local**
- **M 9– Integrar la adaptación en el ciclo del proyecto**

Enfoque de 4 pasos

¿ Course strategy?

First Step
Vulnerability Assessment

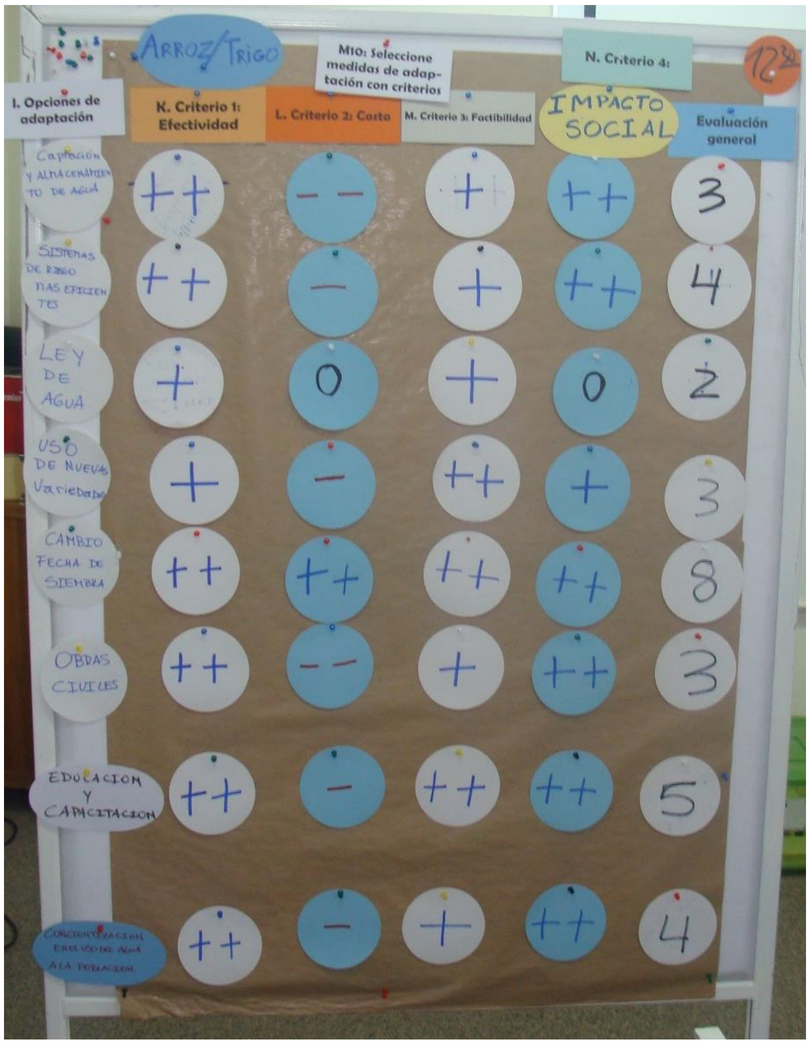


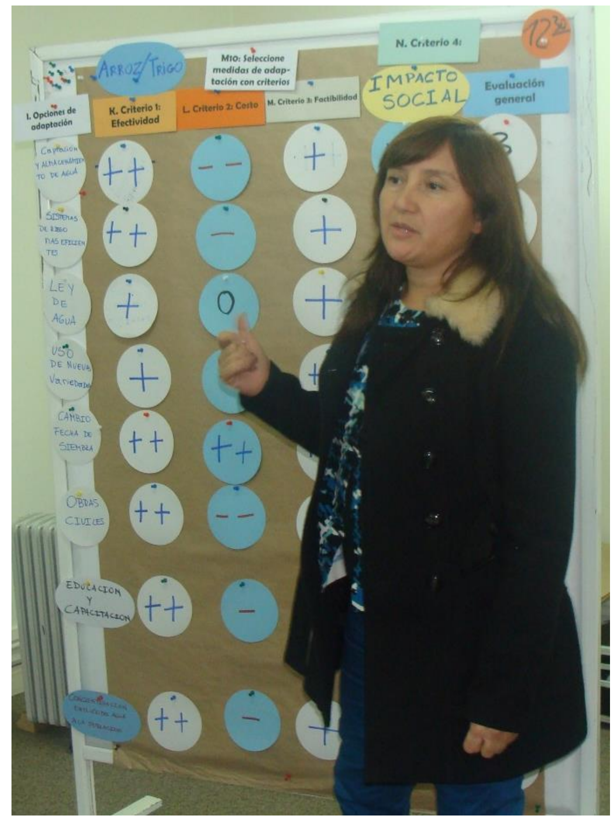
¿ Course strategy?

Second Step
Identification of Adaptation Options

¿ Course strategy?

Third Step
Select Adaptation Measures





¿ Course strategy?

Fourth Step
Develope a monitoring and Evaluation System

¿What we have done?

	Lugar	Institución	Cantidad de Capacitados
1° Edición, Diciembre de 2013	Santiago	INDAP de la Región Metropolitana	13 personas
2° Edición, Agosto de 2014	Santiago	ODEPA, SAG, INDAP, CNR, FIA, Agroseguros	19 personas
3° Edición, Noviembre de 2014	Angol	Equipos Técnicos de los municipios de Renaico, Angol e INDAP de la Región de La Araucanía	18 personas
4° Edición, Marzo de 2015	Santiago	Profesionales de Recursos naturales del SAG y de la CNR	22 personas
5° Edición, Abril de 2015	Temuco	Equipo de transferencia tecnológica de INIA Carillanca e invitados de municipios que participan en proyectos INIA.	14 personas
6° Edición, Julio de 2015	Angol	Equipos Técnicos de los municipios de Renaico y Angol; INDAP, SAG y Gobernación de Malleco de la Región de La Araucanía	19 personas
7° Edición, Agosto de 2015	Traiguén	Equipos Técnicos de los municipios de Ercilla, Traiguén, Los Sauces, e INDAP.	14 personas
8° Edición, Agosto de 2015	Curacautín	Equipos Técnicos de los municipios de Curacautín y Victoria, profesionales de INIA, INDAP, Seremi de Medio Ambiente de la Región de La Araucanía y del proyecto Bosque Modelo.	14 personas
9° Edición, Agosto de 2015	Rancagua	Equipos Técnicos de los diferentes servicios del agro de la Región de O'Higgins (INDAP, INIA, CONAF, SAG) y equipos técnicos de algunos municipios de la Región.	20 personas
10° Edición, Septiembre de 2015	Chillán	Profesionales de INDAP de la Región del Bio Bio y equipos técnicos de algunos municipios de la Región.	25 personas
11° Edición, Mayo de 2016	Quillota	Profesionales de INDAP de la Región de Valparaíso y consultores de la Región.	25 personas
12° Edición, Junio de 2016	Valdivia	Profesionales de INDAP de la Región de Los Ríos, técnicos de algunos municipios de la Región.	18 personas
13° Edición, Julio de 2016	La Serena	Profesionales de INDAP de la Región de Coquimbo.	22 personas
14° Edición, Agosto de 2016	Talca	Profesionales de INDAP y extensionistas de las regiones del Maule y O'Higgins.	20 personas
15° Edición, Noviembre de 2016	Puerto Montt	Profesionales de INDAP de la Región de Los Lagos.	18 personas
16° Edición, Abril de 2017	Puren	Extensionistas del Territorio Nahuelbuta	20 personas
17° Edición, Mayo de 2017	San Fernando	Profesionales de INDAP de la Región de O'Higgins.	24 personas

In Short….

IICA's technical cooperation related to climate change consists of:

- Tangible, practical and appropriate products
- Access to relevant information
- Training and Institutional Strengthening
- Supporting processes, strategies and policies
- Facilitating inter-sectoral and inter-ministerial synergies
- Facilitating cooperation at the hemispheric, regional, national and local level

IICA

Our Commitment: Results

Instituto Interamericano de Cooperación para la Agricultura

José Javier Gómez, Unit of Climate Change Sustainable Development and Human Settlements Division, CEPAL, UN. Presentation: Climate Change and sustainability in Latin America and the Caribbean

Smallholders Response to New Climate Scenarios APEC

Santiago, 30 November 2017

Climate Change and sustainability in Latin America and the Caribbean

UNITED NATIONS

ECLAC

Sustainable Development and Human Settlements Division
Economic Commission for Latin America and the Caribbean

José Javier Gómez

Index

I. Latin American and Caribbean GHG emissions pattern

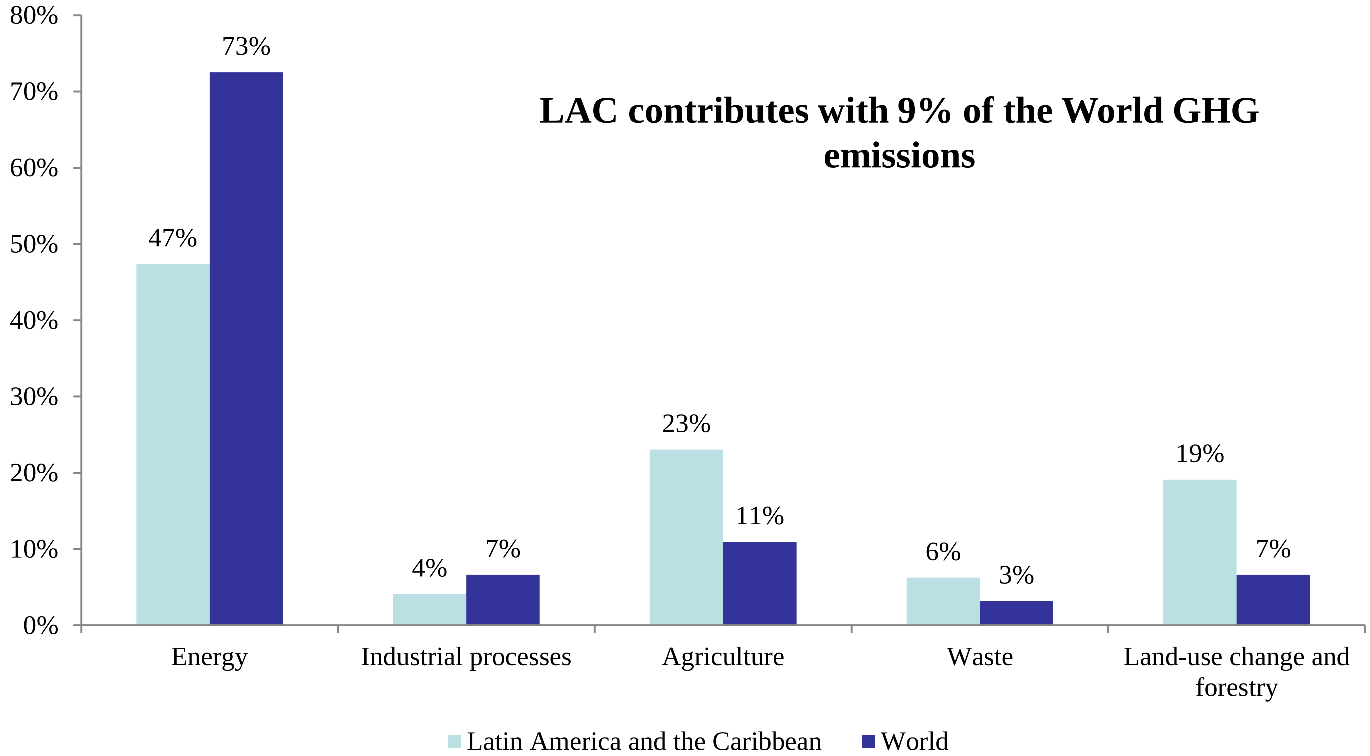
II. NDCs and climate change impacts in agriculture

III. Areas of concern (food security)

IV. Conclusions

A different GHG emissions pattern

World and Latin America and the Caribbean
GHG emissions by sector, 2014



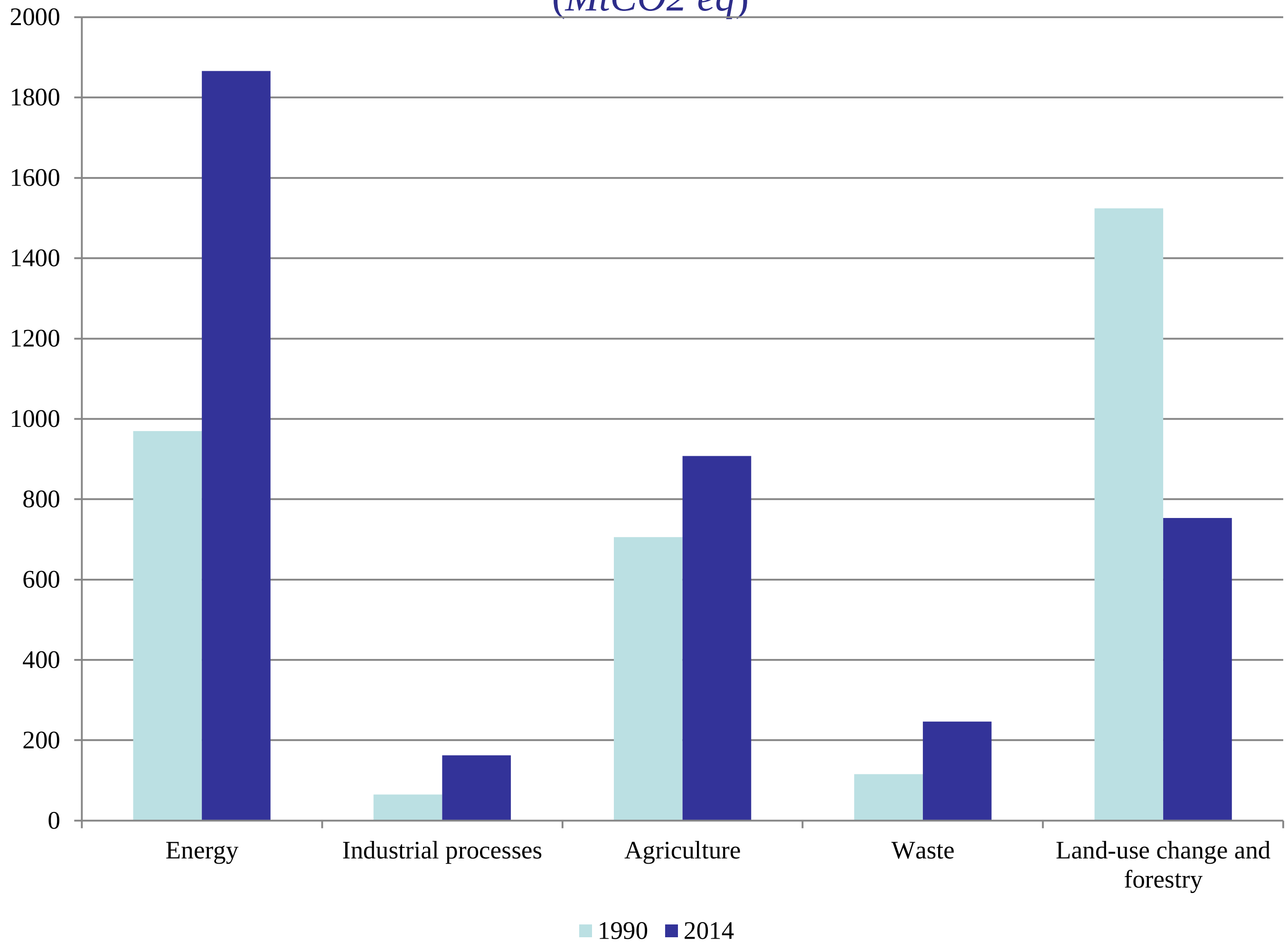
In six countries of Latin America the main source of GHG emissions is Land-use change and forestry: Bolivia, Ecuador, Honduras, Nicaragua, Paraguay and Perú

Source: World Resources Institute (WRI), Climate Analysis Indicators Tool (CAIT) 2.0. ©2014. Washington, D.C. [online] http://cait2.wri.org.

Latin America and the Caribbean: GHG Evolution

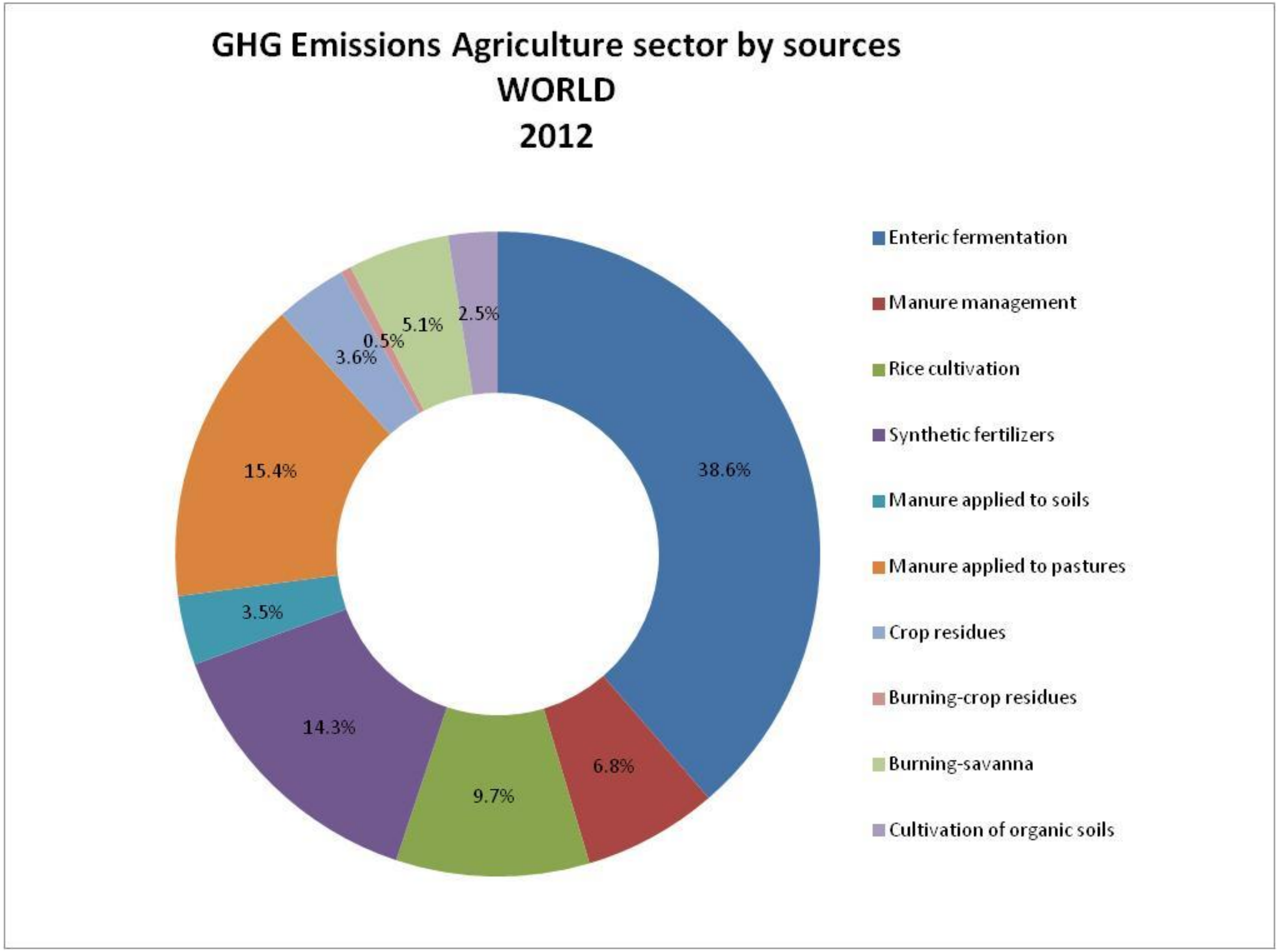
GHG emissions by sector, 1990 and 2014

(*MtCO2 eq*)



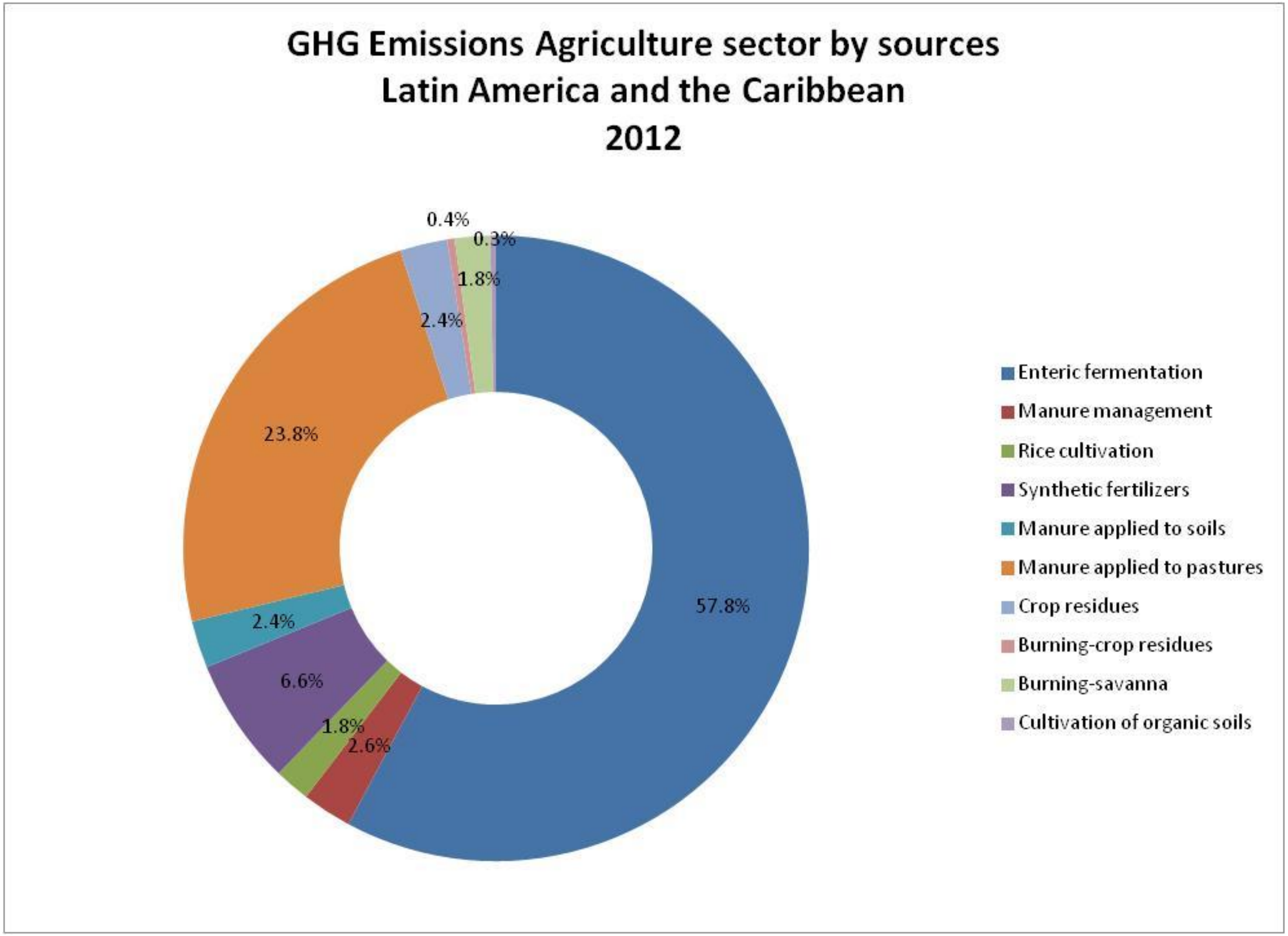
Source: World Resources Institute (WRI), Climate Analysis Indicators Tool (CAIT) 2.0. ©2014. Washington, D.C. [online] http://cait2.wri.org.

Within the agriculture sector a different pattern of GHG emissions by source



Source: World Resources Institute (WRI), Climate Analysis Indicators Tool (CAIT) 2.0. ©2014. Washington, D.C. [online] http://cait2.wri.org.

Within the agriculture sector a different pattern of GHG emissions by source



Source: World Resources Institute (WRI), Climate Analysis Indicators Tool (CAIT) 2.0. ©2014. Washington, D.C. [online] http://cait2.wri.org.

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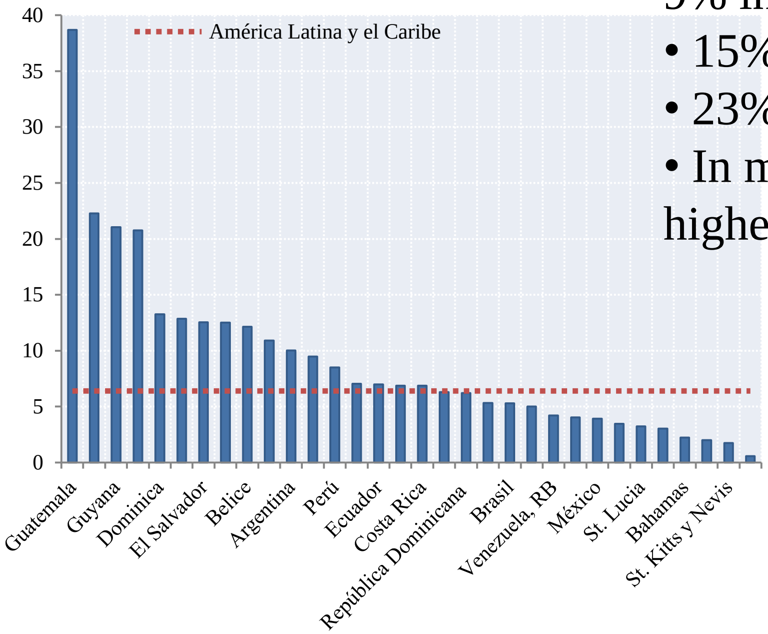
Share of agriculture in Regional GDP

Share of agriculture in GDP
Latin America and the Caribbean, 2010
(%)



- It accounts around 6% of LAC GDP from 9% in 1990, but
- 15% of total employment
- 23% of regional exports
- In most countries rural poverty is much higher tan urban poverty

Source: prepared b y ECLAC based on statistical information of the World Bank (*World Development Indicators*).

Latin American and Caribbean NCDs

Mitigation

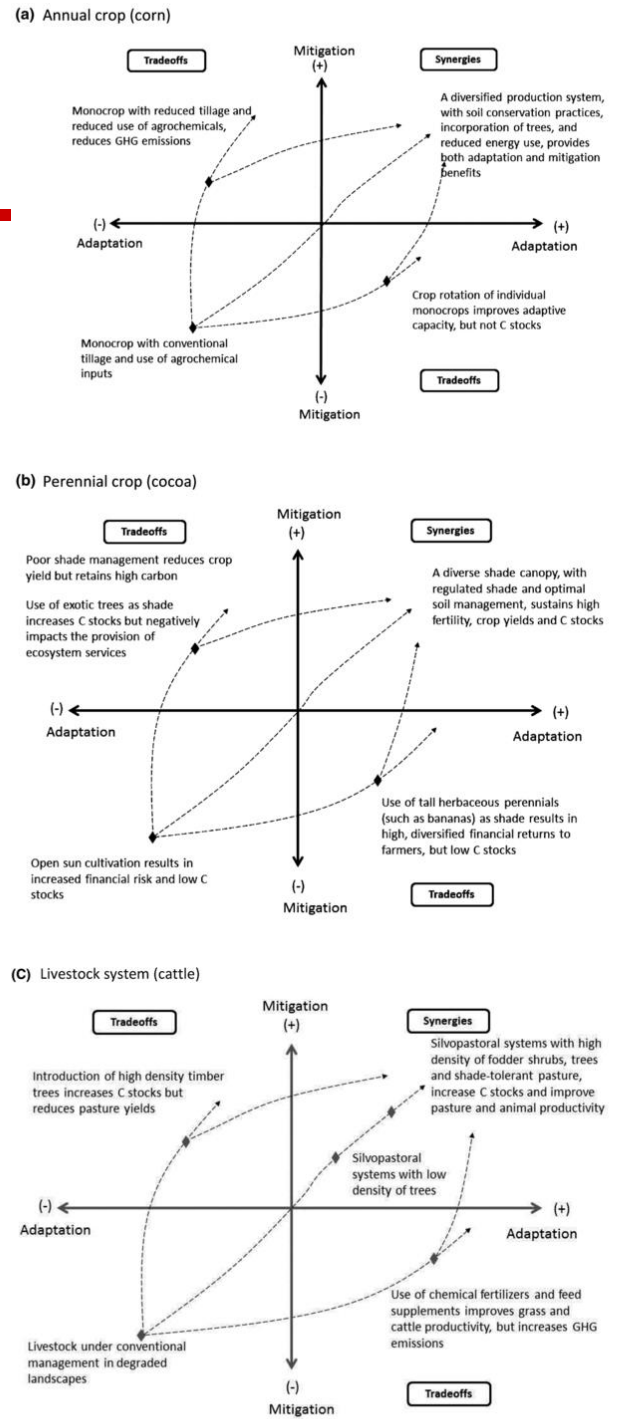
- It is difficult to estimate a regional reduction target since countries use different assumptions and baseline years. In most cases there are unconditional and conditional targets, the last ones depending on international support (financing, technology transfer, capacity strengthening)
- Major GHG emitters committed ambitious target in 2030 (Brazil 43%; México 22%-40%; Argentina 15%-30%; Colombia 20%-30%)
- In line with the main sources of GHG emissions, prioritized sectors are:
  - Energy (including transport)
  - Land-use change and forestry
  - Agriculture
- Most countries have set specific targets in forests but none in agriculture

Latin American and Caribbean NCDs

Adaptation

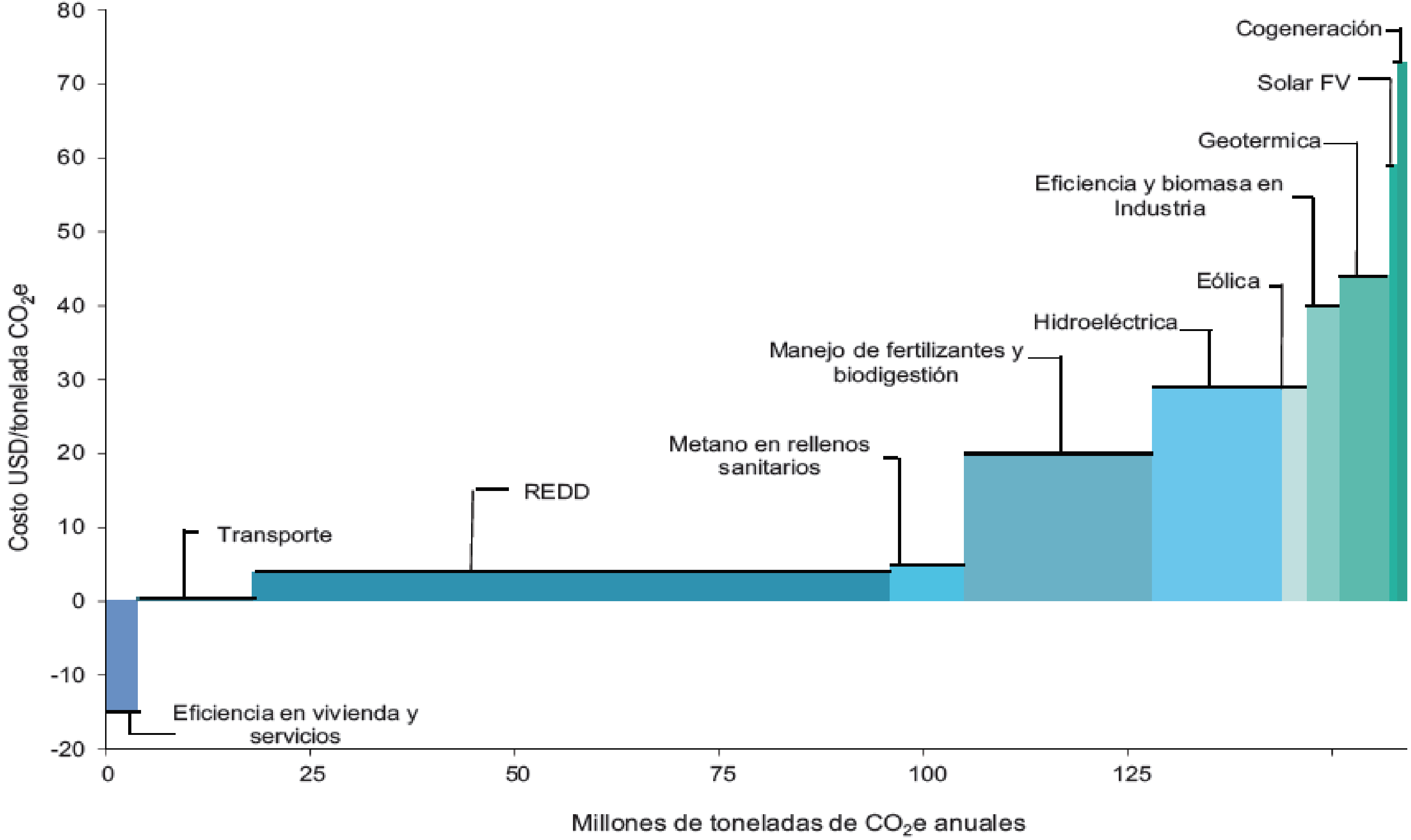
- Agriculture is the most important sector for adaptation strategies. Forests and risk reduction to extreme events are also frequently mentioned
- Some countries propose interesting approaches such as:
  - Adaptation based on ecosystems
  - Watershed management
  - Synergies between adaptation and mitigation (SAM)
- Measures and areas of agriculture adaptation mentioned include:
  - Research on drought resistant seeds
  - Increase irrigation efficiency and water management
  - New irrigation infrastructure (including increasing water storage capacity)
  - Improvement of weather monitoring systems
  - Agriculture insurance systems

Examples of synergies and trade-offs mitigation-adaptation in agriculture and forestry decisions



Fuente: Harvey et al. 2014

Marginal costs of reduction in Central America



Fuente: CEPAL/CCAD/DFID (2010), La economía del cambio climático en Centroamérica, Síntesis. México, D.F.

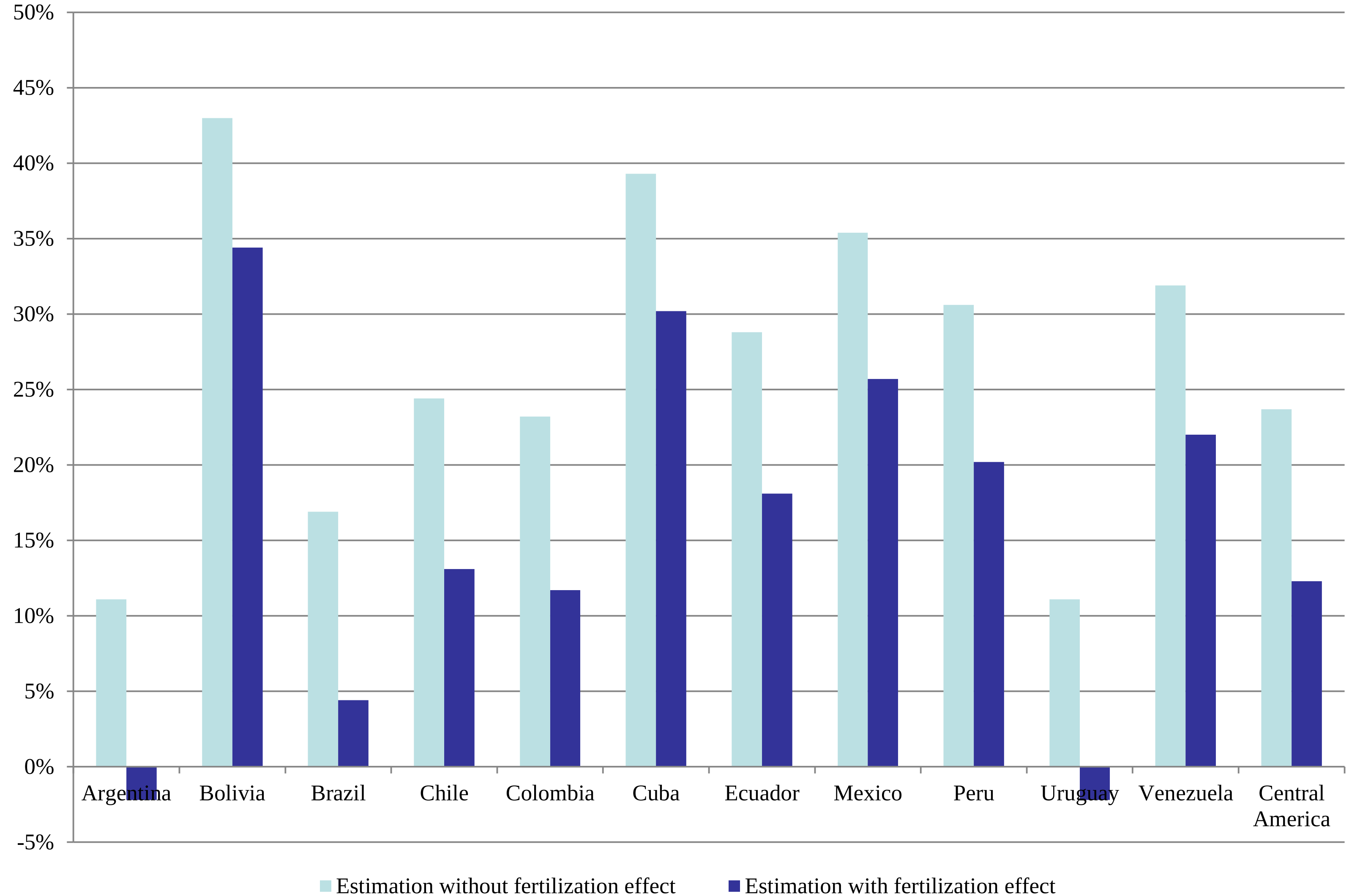
Impacts in agriculture sector

Changes in revenues associated with rising temperatures based on Ricardian models [a]

Authors	Country	Increase in temperature *(degrees Celsius)*	Revenue change *(percentages)*
Sanghi and Mendelsohn (1998) [b]	Brazil	2.0	-5 to -11
		3.5	-7 to -14
Mendelsohn, and others (2000) [c]	South America	2.0	0.18 to 0.46
Lozanoff and Cap (2006) [d]	Argentina	2.0 a 3.0	-20 to -50
Timmins (2006)	Brazil	2.0	-0.621
González and Velasco (2008)	Chile	2.5 and 5.0	0.74 y 1.48
Seo and Mendelsohn (2007) [e]	South America	1.9. 3.3 and 5	-64. -38 and -20 (small farms)
			-42. -88 and -8 (large farms)
Mendelsohn and Seo (2007a) [f]	South America	1.4 to 5.1	-9.3 to -18.9
		1.3 to 3.2	-5.0 to -19.1
		0.6 to 2.0	41.5 to 49.5
Mendelsohn and Seo (2007b) [g]	South America	1.4 to 5.1	Exogenous: -6.9 to -32.9 Endogenous: -5.4 to -28.0
		1.3 to 3.2	Exogenous: -5.7 to -17.6 Endogenous: -4.2 to -19.0
		0.6 to 2.0	Exogenous: 4.7 to 0.1 Endogenous: 9.7 to -1.1
Mendelsohn and otros (2007b)	Brazil	10 [h]	-33
Seo and Mendelsohn (2008b)	South America	5.1 to 2.0	-23 to -43
Seo and Mendelsohn (2008a)	South America	1.9. 3.3 and 5	-14.2 to -53.0
			-14.8 to -30.2
			2.3 to -12.4
Sanghi and Mendelsohn (2008) [i]	Brazil	1.0 to 3.5	-1.3 to -38.5
Mendelsohn, Arellano and Christensen (2010) [j]	México	2.3 to 5.1	-42.6 to -54.1
Cunha and others (2010) [k]	Brazil	2.0	-14
Seo (2011) [l]	South America	1.2. 2.0 and 2.6	-26 to 17 (private irrigation)
			-12 to -25 (public irrigation)
			-17 to -29 (dry farming)

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of the authors cited in the table.
[a] Estimates do not take the CO2 fertilization effect into account. Positive values denote benefits and negative ones denote damage.
[b] The climate scenario is based on a 7% increase in precipitation.
[c] Impacts as a percentage of GDP.
[d] The climate scenario is based on a -5% to 10% change in precipitation levels.
[e] Mean precipitation levels could increase (or decrease) in some countries, but there will be a reduction (or increase) in rainfall.
[f] Precipitation increases and diminishes over time, with no apparent pattern being observed.
[g] The exogenous model predicts more serious damage and fewer benefits than the endogenous model for all scenarios. The differential increases over time.
[h] Percentages.
[i] The climate scenario is based on a change of between -8% and 14% in precipitation levels.
[j] A series of climate change scenarios include projections of increased or decreased annual precipitation levels.
[k] Farmers' revenues tend to rise for those with irrigated farmland but tend to fall for those practising dry farming.
[l] Predictions based on the climate scenario include overall increases and decreases in precipitation levels. South America: Argentina, the Bolivarian Republic of Venezuela, Brazil, Chile, Colombia, Ecuador and Uruguay.

Loss of agriculture output (2080 with respect to 2003)

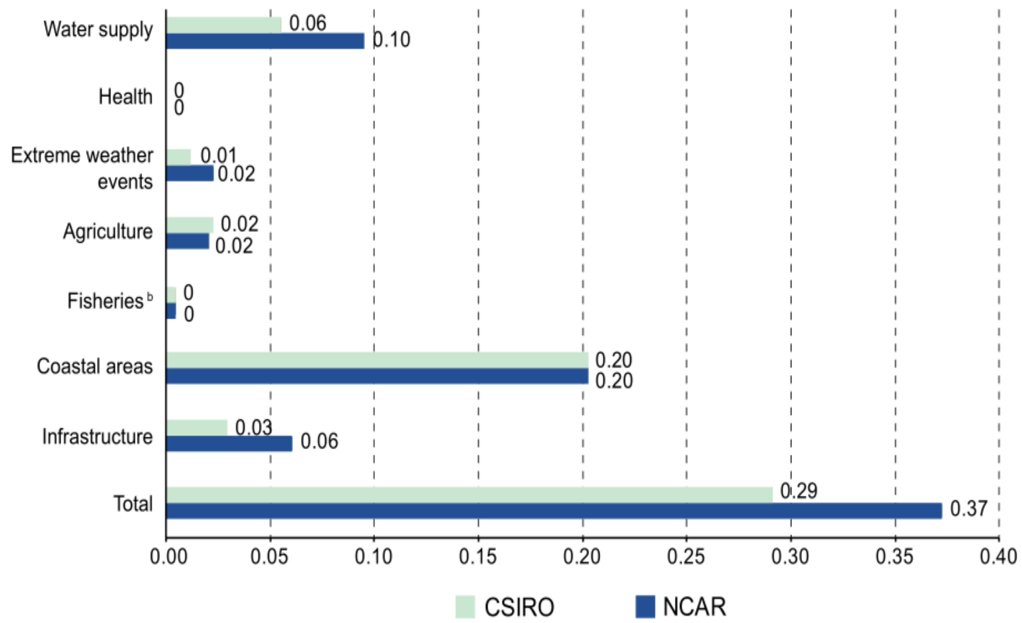


Source: Cline, R. (2007) *Global Warming and Agriculture: Impact estimates by country, Petersen Institute*

Adaptation costs by sector

Latin America and the Caribbean: annual costs of adaptation, to 2050 [a]

(Percentages of regional GDP)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of World Bank, *The Cost to Developing Countries of Adapting to Climate Change. New Methods and Estimates*, Washington, D.C., June 2010.

[a] NCAR: National Centre for Atmospheric Research (wettest scenario); CSIRO: Commonwealth Scientific and Industrial Research Organization (driest scenario).

[b] In the fisheries sector, the average range is between 0.18 and 0.36 (NCAR) and between 0.18 and 0.35 (CSIRO).

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Facts and figures (SDG 2)

Facts and figures regarding food security (Agenda 2030)

- Agriculture is the single largest employer in the world, providing livelihoods for 40 per cent of today's global population. It is the largest source of income and jobs for poor rural households.
- 500 million small farms worldwide, most still rainfed, provide up to 80 per cent of food consumed in a large part of the developing world. Investing in smallholder women and men is an important way to increase food security and nutrition for the poorest, as well as food production for local and global markets.

Areas of concern

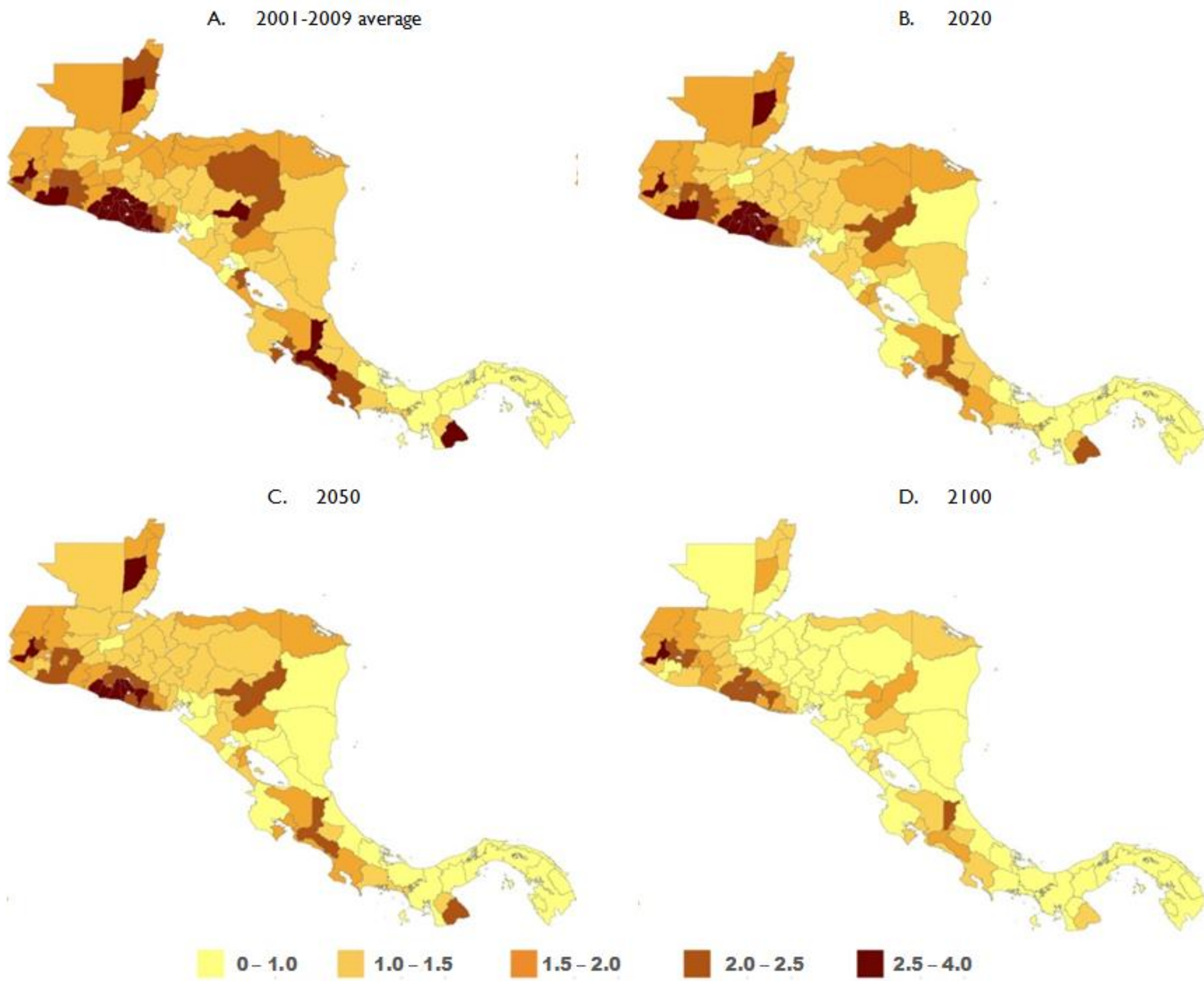
- The Andean region of South America, where melting glaciers and snowcaps will drive climate, migration, and security concerns. The average rate of glacial melting has doubled over the past few years, according to the World Glacier Monitoring Service. Besides Peru, which faces the gravest consequences in Latin America, a number of other Andean countries will be massively affected, including Bolivia, Ecuador, and Colombia. This development will put water security, agricultural production, and power generation at risk—all factors that could prompt people to leave their homes and migrate. The IPCC report argues that the region is especially vulnerable because of its fragile ecosystem.

- In addition to some areas of Andean countries, subsistence farming could be severely threatened in some parts of Latin America, including northeastern Brazil and Central America.

Source: Climate Change, Migration and Conflict, Addressing complex crisis scenarios in the 21st Century, Werz M. y Conley L. 2012)

Central America: corn yields by department, average 2001-2009 and scenario A2

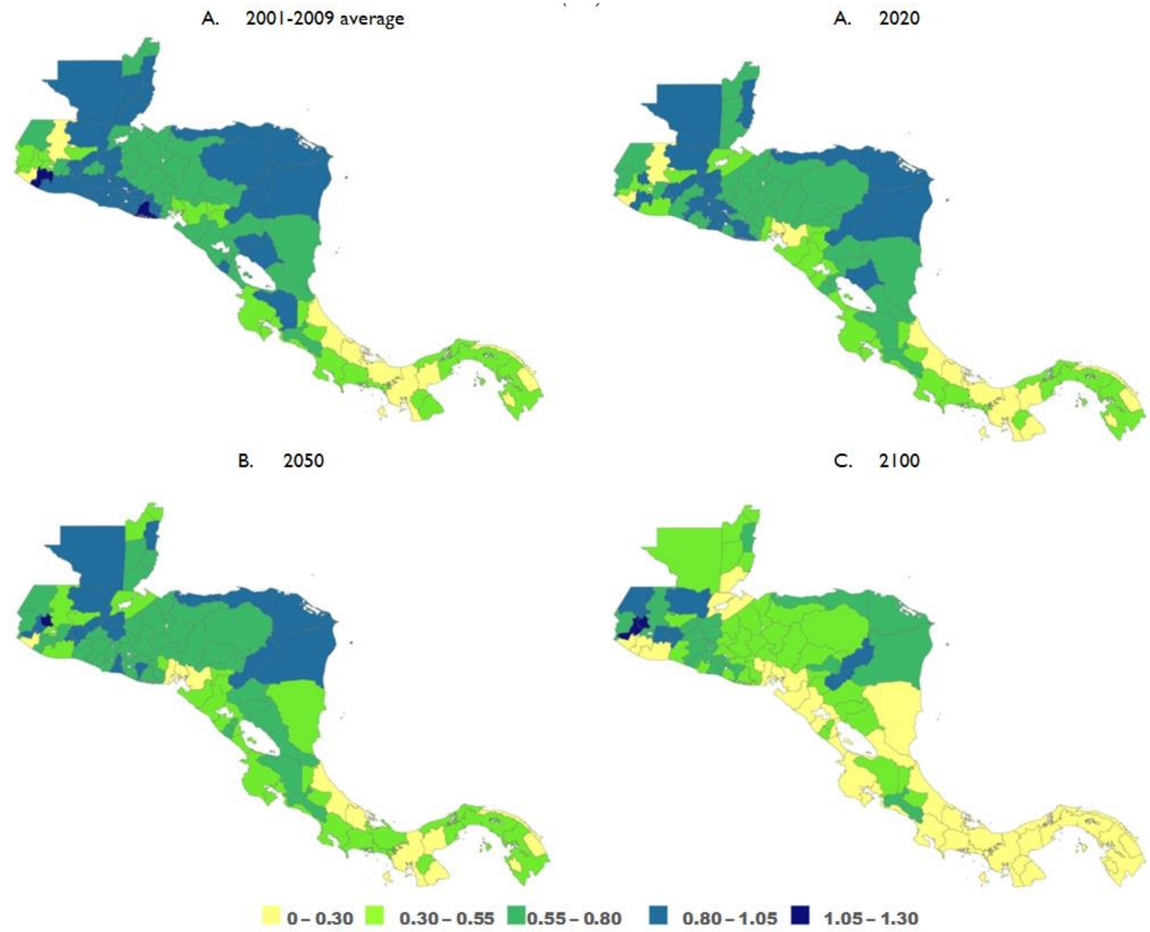
(tons/hectare)



Source: ECLAC, Climate Change in Central America: potential impacts and policy options, 2015

Central America: bean yields by department, average 2001-2009 and scenario A2

(tons/hectare)



Source: ECLAC, Climate Change in Central America: potential impacts and policy options, 2015

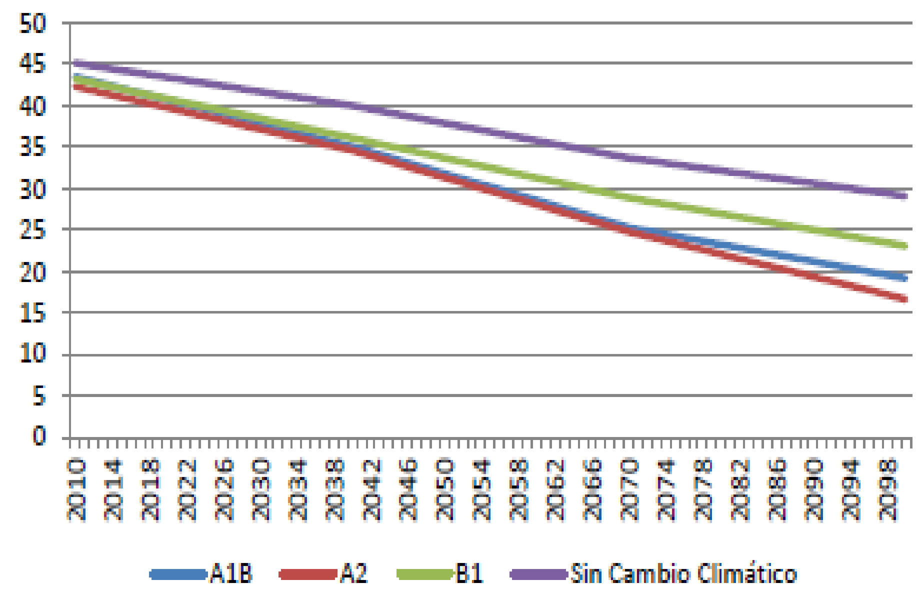
Peru: Impact of climate change in livestock grazing of Altiplano, scenarios A1B, A2 y B1a,

(millions of sheep units)

GRÁFICO V.5

Impacto del cambio climático en la carga animal total para la puna

(En millones de unidades ovinas)



Fuente: Elaboración propia.

Source : ECLAC, IADB Impact of Climate Change in Peru, 2014

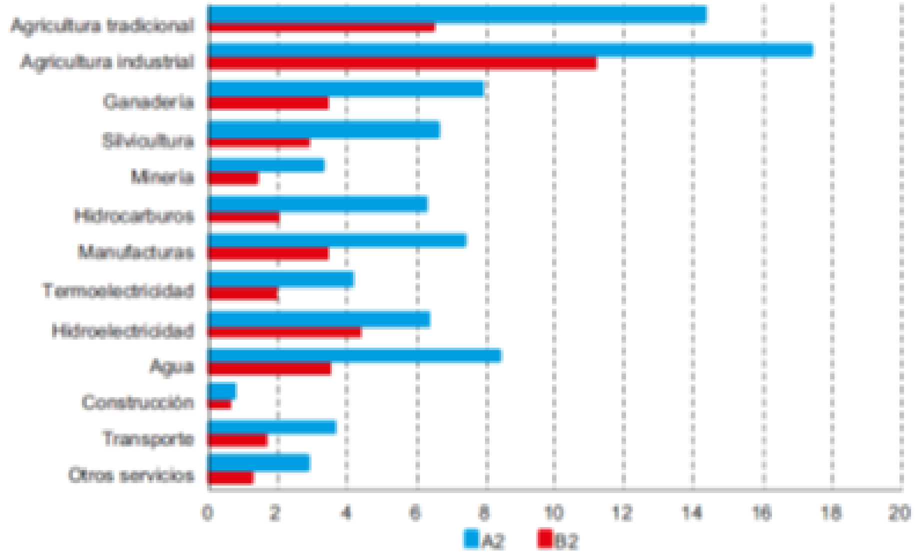
Plurinational State of Bolivia: loss by sector with respect to sectoral GDP, scenarios A2 y B2

(percentages of the present value of sectoral GDP)

Gráfico IV.9

Pérdidas sectoriales en valor presente con respecto al valor presente del PIB sectorial del escenario base, escenarios A2 y B2

(En porcentajes del valor presente neto del PIB sectorial)

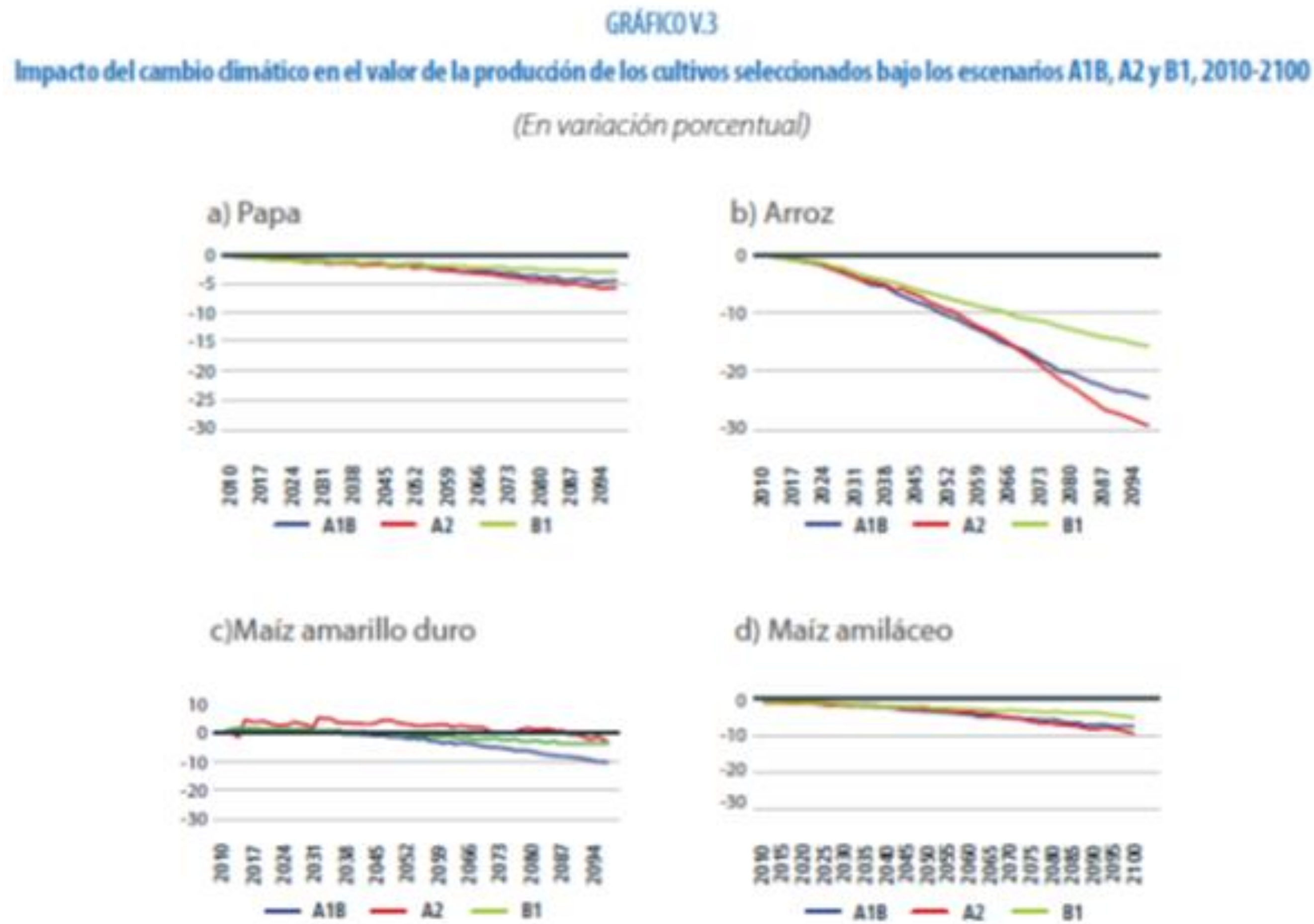


Fuente: Elaboración propia.
Nota: Los resultados se calculan con una tasa de descuento del 0,5%.

Fuente: Source : ECLAC, IADB Impact of Climate Change in Plurinational State of Bolivia, 2014

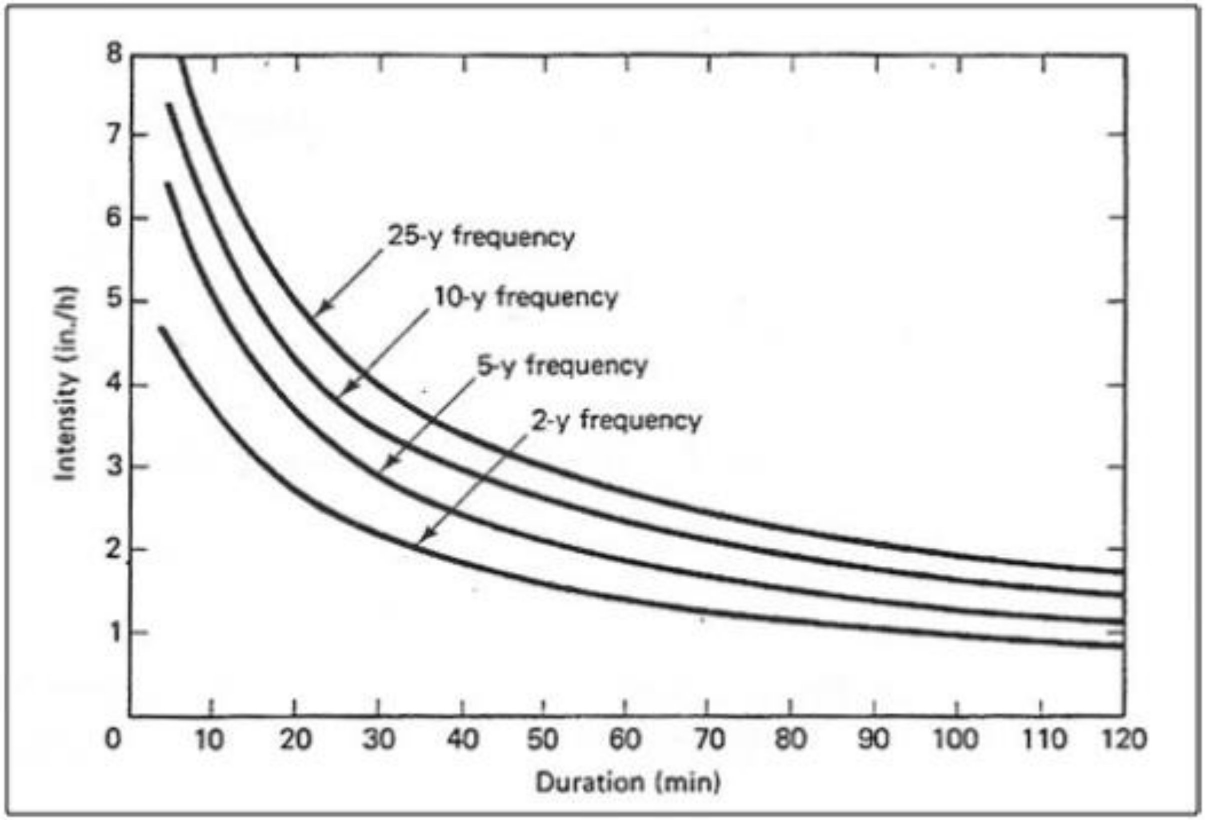
Peru: impact of climate change in the production value of selected crops scenarios A1B, A2 y B1, 2010-2100

(percentage change)

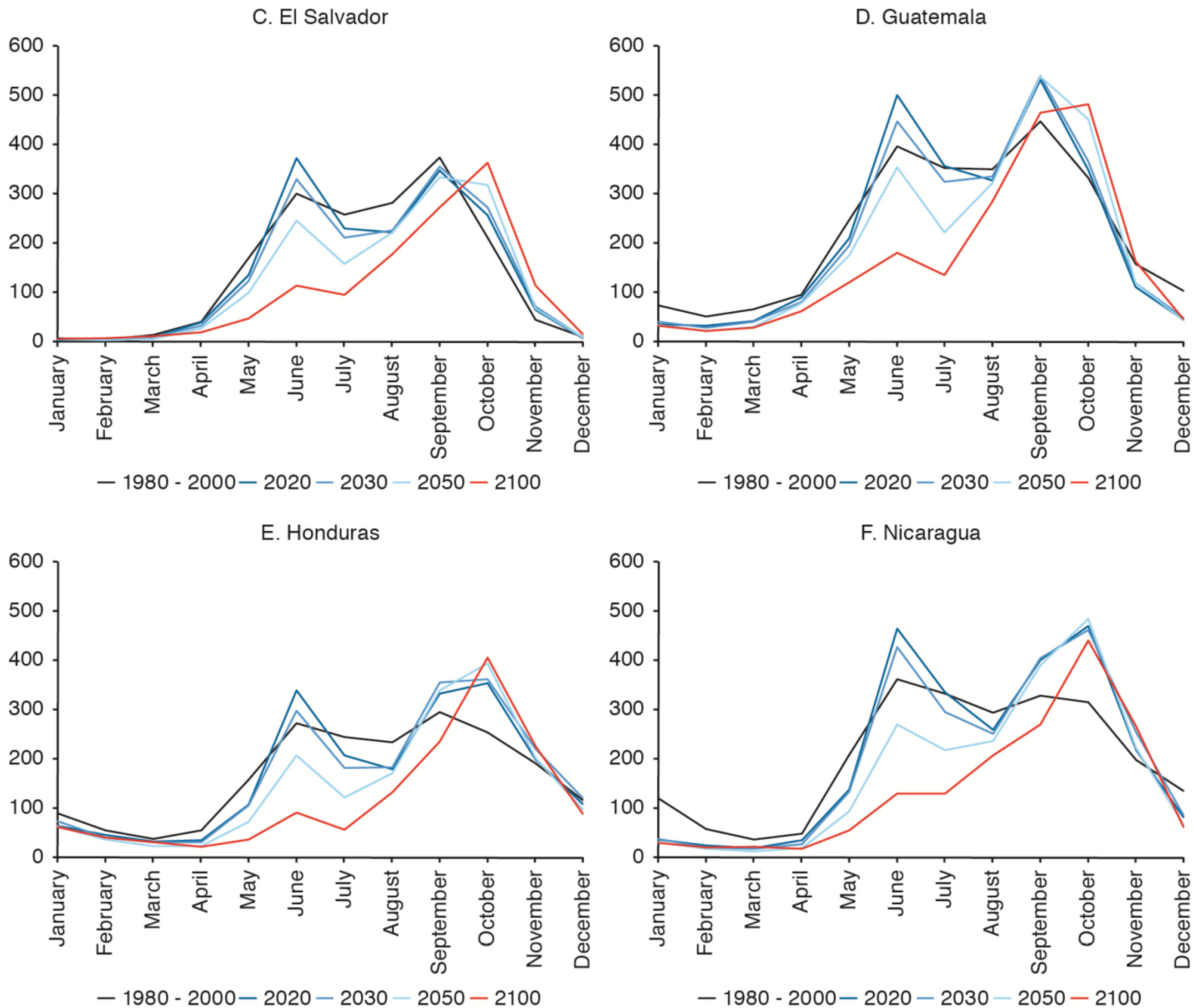


Source : ECLAC, IADB Impact of Climate Change in Peru, 2014

¿More intense rains?



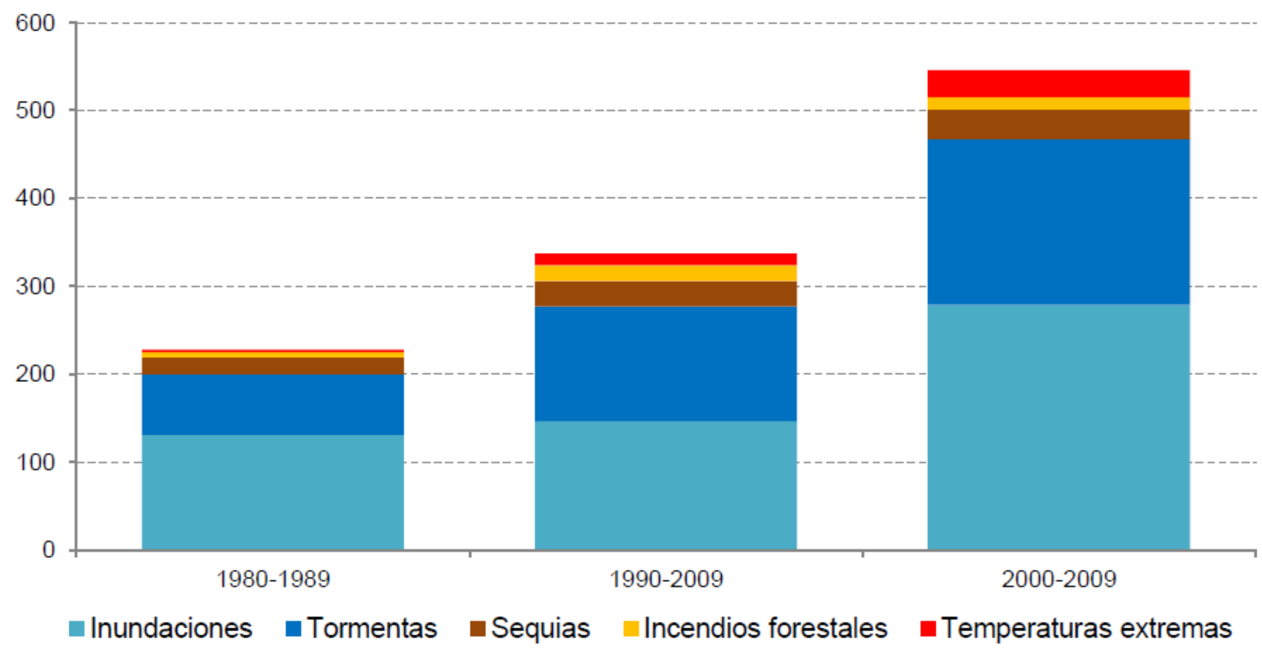
Central America (selected countries): monthly rainfall, average and scenario A2a



Source: ECLAC, Climate Change in Central America: potential impacts and policy options, 2015

An increasing number of disasters

Gráfico 2
Eventos hidrometeorológicos extremos en América Latina y el Caribe
(Número de eventos por década)



Fuente: EM-DAT data base (http://www.emdat.be).

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Conclusions

- Water scarcity is likely the most important way by which climate change will afect LAC countries. However, in most countries of the region water governance and management need major improvements.
- Therefore, main adaptation measures are linked to water issues (such as drought resistant crops, water management and infrastructure) and effectiveness of the water institutionality should be assessed
- In this regard, existing and future irrigation infrastructure projects should be reviewed under future climate change scenarios.
- Lastly, it is necessary that policy decisions were based in the best scientific knowledge. In this sense, having information systems that allow to monitor the changes is crucial.

Source: Climate Change, Migration and Conflict, Addressing complex crisis scenarios in the 21st Century, Werz M. y Conley L. 2012)

Smallholders Response to New Climate Scenarios APEC

Santiago, 30 November 2017

Thank you very much

UNITED NATIONS

ECLAC

Sustainable Development and Human Settlements Division
Economic Commission for Latin America and the Caribbean

José Javier Gómez

César Dávila, Fondo Sierra Azul Ministry of Agriculture and Irrigation of Peru.

Sierra Azul Peruvian experience of public investment on seeding and water harvesting

PERÚ

Ministerio
de Agricultura y Riego

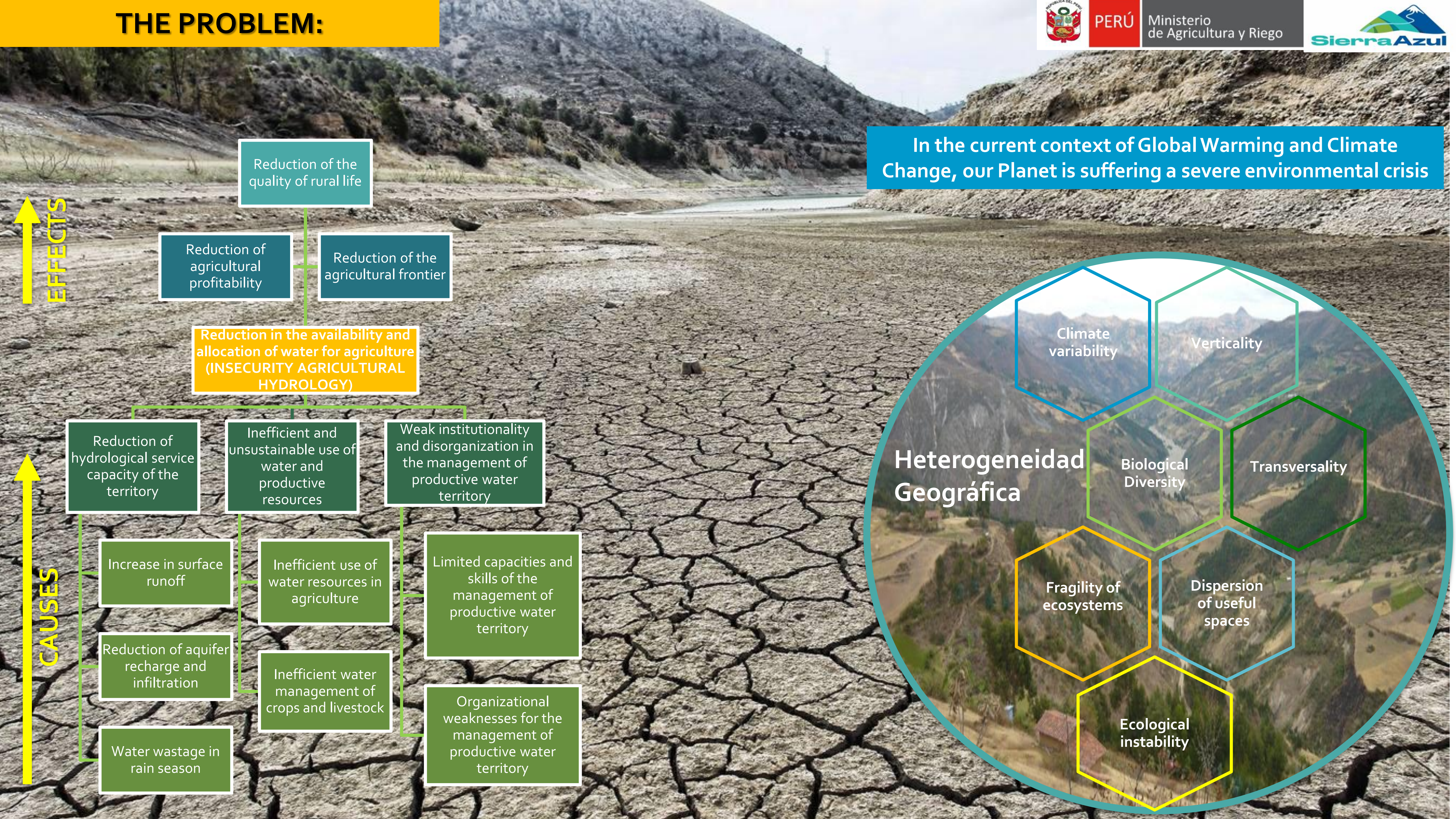
PERUVIAN EXPERIENCE OF PUBLIC INVESTMENT ON SEEDING AND WATER HARVESTING




SierraAzul

Eng. César Dávila Veliz
Executive Director
Unidad Ejecutora Fondo Sierra Azul

November 2017

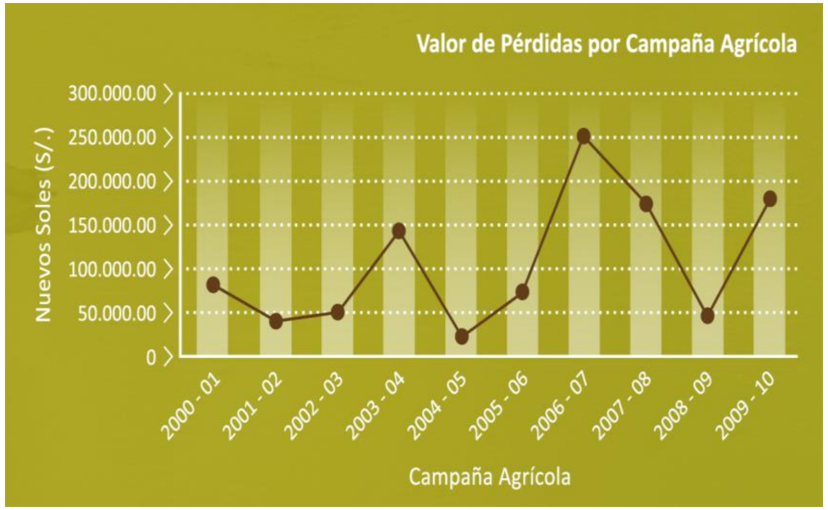


THE PROBLEM:
PERÚ Ministerio de Agricultura y Riego
SierraAzul
In the current context of Global Warming and Climate Change, our Planet is suffering a severe environmental crisis
EFFECTS
CAUSES
Reduction of the quality of rural life
Reduction of agricultural profitability
Reduction of the agricultural frontier
Reduction in the availability and allocation of water for agriculture (INSECURITY AGRICULTURAL HYDROLOGY)
Reduction of hydrological service capacity of the territory
Inefficient and unsustainable use of water and productive resources
Weak institutionality and disorganization in the management of productive water territory
Increase in surface runoff
Reduction of aquifer recharge and infiltration
Water wastage in rain season
Inefficient use of water resources in agriculture
Inefficient water management of crops and livestock
Limited capacities and skills of the management of productive water territory
Organizational weaknesses for the management of productive water territory
Heterogeneidad Geográfica
Climate variability
Verticality
Biological Diversity
Transversality
Fragility of ecosystems
Dispersion of useful spaces
Ecological instability

DANGERS, RISKS AND IMPACTS IN AGRICULTURE

The Agricultural Sector is highly vulnerable to the effects of climate change. Year to year losses are recorded in the sector due to weather events as shown below:

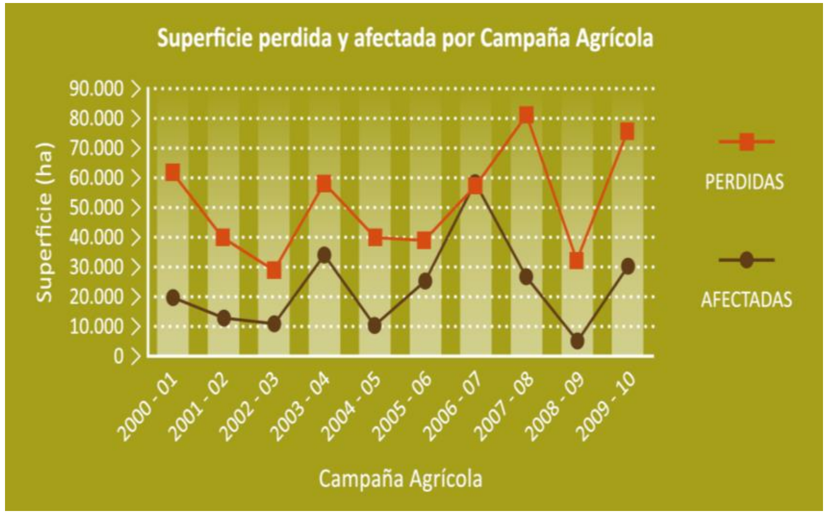
Graph 1: Losses in the Agricultural Sector (2000-2010)



Agricultural sector: ¼ of the labor force (3/4 in rural areas), 4.5% of GDP, 9% of exports

Irrigated agriculture: 1/3 of the cultivated area; 2/3 of the value of agricultural production and more of exports

Graph. 2: Lost and affected crops (2000-2010)



Fuente: PLANGRACC-A, MINAGRI

WATER MANAGEMENT IS PROBABLY THE CULTIVATION TECHNIQUE THAT MOST MUST BE IMPROVED IN THE FUTURE

For the fight against poverty and food security: 50% of the rural population is poor; > 50% of the poor population is rural; it allows improving farm incomes and stabilizing food prices;

For the management of Water Resources: 80% of water uses;

Expansion and improvement of irrigation is a measure of adaptation to climate change; but even the irrigated areas are vulnerable (eg 40% of the cultivated area susceptible to flooding).

FOCUS:

PERÚ | Ministerio de Agricultura y Riego

SierraAzul

Conventional approach: appropriate for lowland lands..

Base on the use of permanent sources, with flow measurements in the period of máximum dry season; Surface water storage through large reservoirs and massive extraction of groundwater.

Based on the collection, storage and regulation of water in the soil and reservoirs of different sizes, and the use of temporary and permanent sources throughout its hydrological cycle for different uses.

Non-conventional approach: appropriate for highland areas

CONCEPTUAL FRAMEWORK

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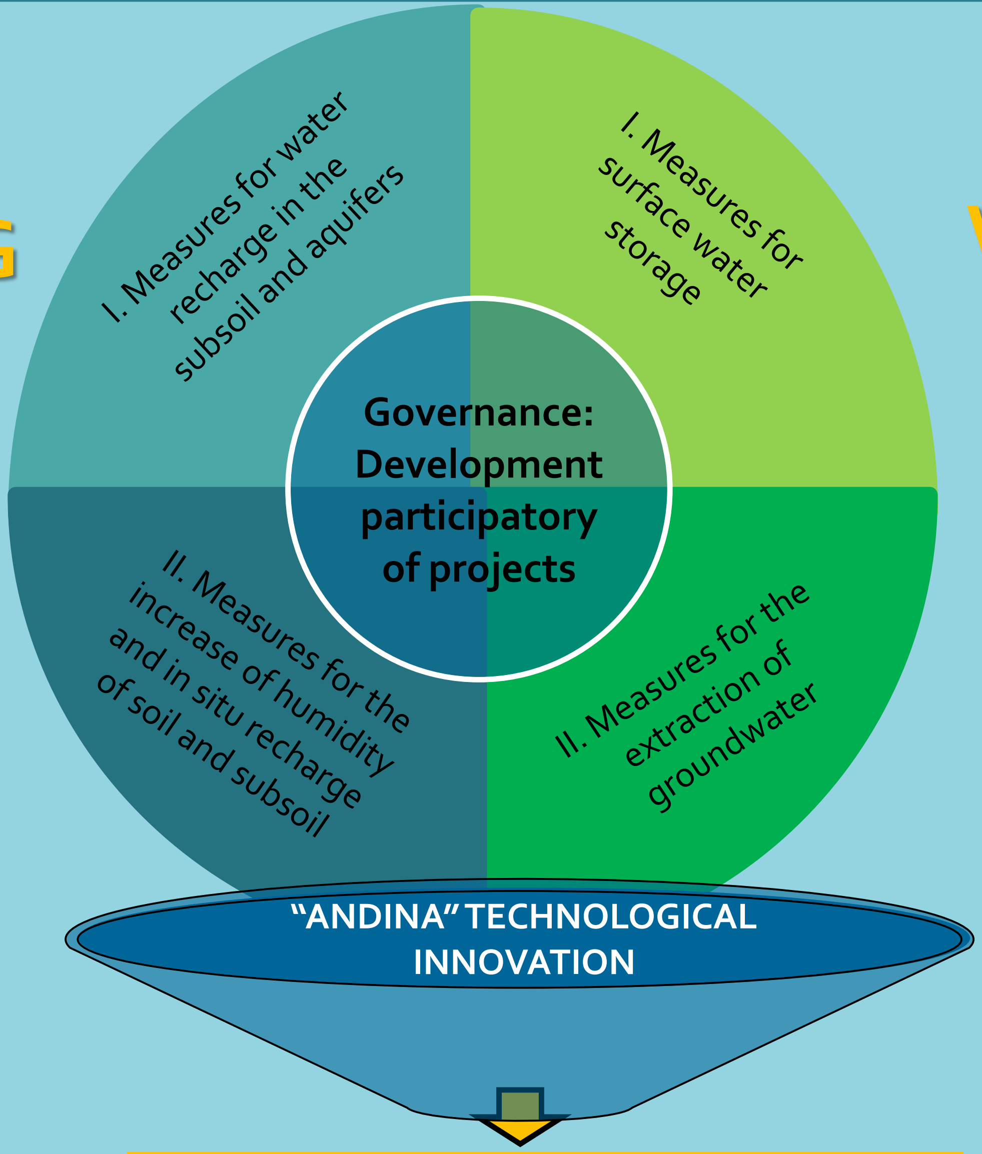
Sierra Azul

WATTER SEEDING

Measures oriented to the hydric recharge of aquifers, subsoil and increase of soil moisture



WATER HARVEST

Measures oriented to the collection, storage and regulation of wáter by reservoirs of different volumes

FAMILY AGRICULTURE AND FOOD SECURITY

MANAGEMENT PROPOSAL FOR MICROBASIN

PERÚ Ministerio de Agricultura y Riego

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RESOURCES MANAGEMENT: SEEDING AND

- Water as an integrating element of the environment, society and production.
- Environmental education as a social mobilizer
- The basin as a natural space for water management
- Water management based on seeding and harvesting water: rainfall and flows
- Conservation and management of soil by basin and hydraulic systems.
- Agricultural production, social organization and environmental management, integrated to the hydraulic systems.

Sierra Azul promotes a cultural movement towards sustainability

- Articulating institutions and personalities
- Adding efforts of social, public and private institutions.
- Dividing responsibilities in institutions around a common vision.
- Sharing experiences and resources

BENEFITS

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a) Protection and improvement of water and soil availability

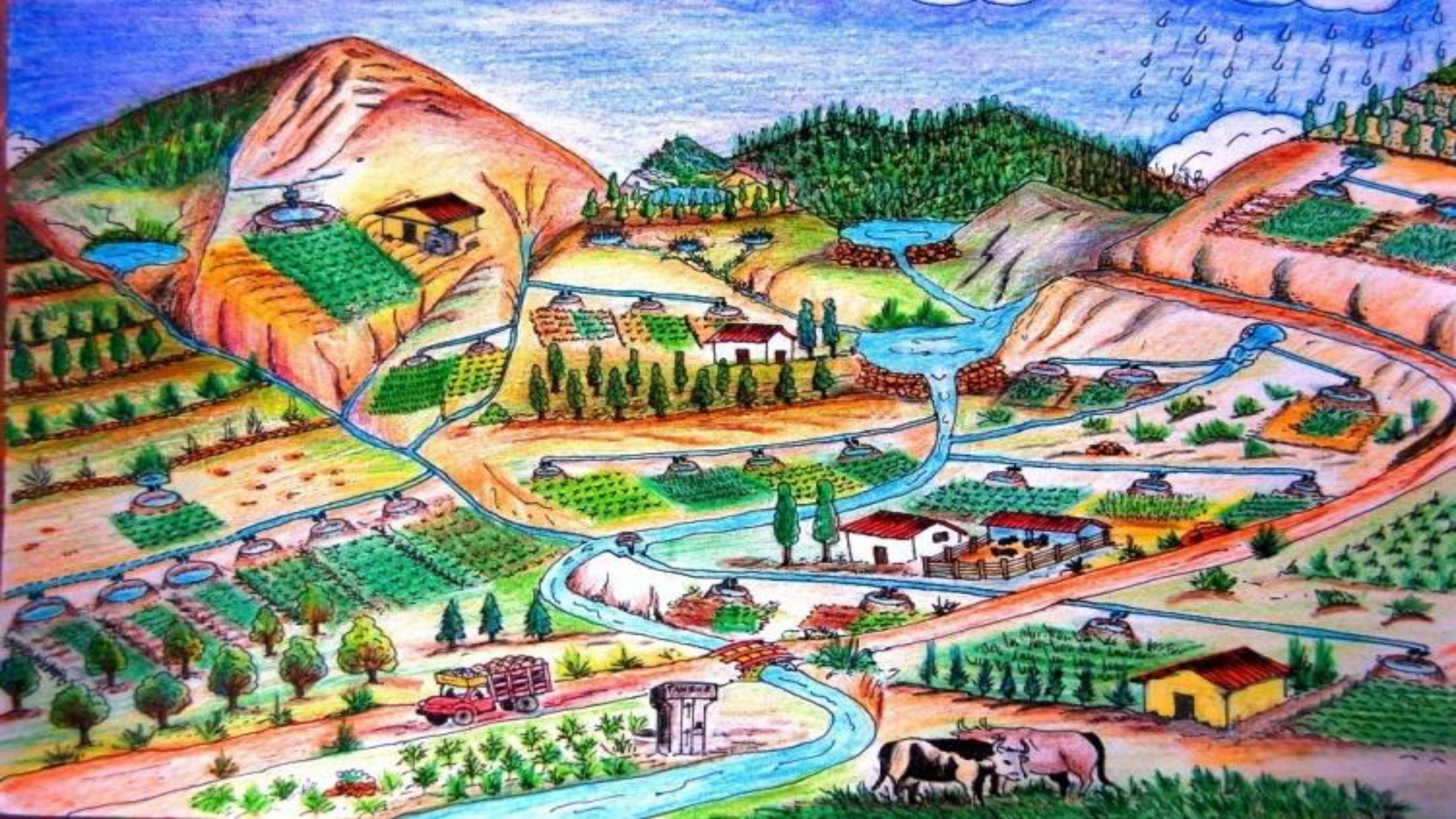
- 1.- Increase and regulation of water availability
- 2.- Control of water erosion
- 3.- Regeneration of the Hydrological Cycle
- 4.- Mitigation of extreme hydrological events

b) Improvement of the environment and natural landscape

- 1.- Regeneration and improvement of plant cover
- 2.- Regeneration and improvement of biodiversity
- 3.- Contribution to decontamination Environmental
- 4.- Improvement of the landscape and environment

c) Improvement of the socio-economic conditions of the population

- 1.- Increase in agricultural production
- 2.- Increase in livestock production
- 3.- Increase in forest production
- 4.- Revenue from environmental services
- 5.- Increase in eco-tourism and experiential tourism
- 6.- Revaluation of their lands, natural landscapes and their biodiversity
- 7.- Generation of productive employment
- 8.- Improvement of socio-economic conditions of rural families: Fight against poverty in a sustainable way



North Zone Experience: CAJAMARCA

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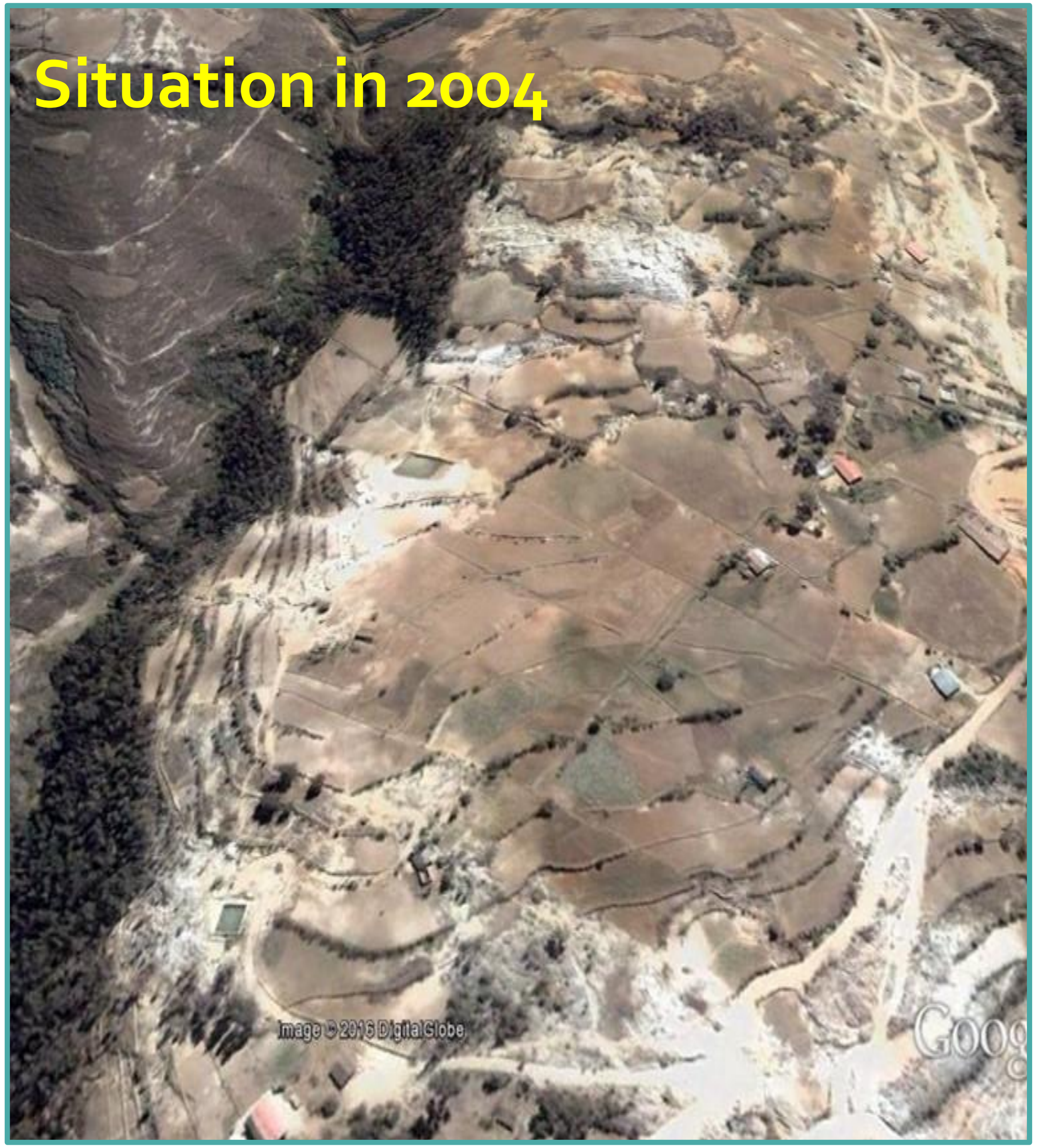
Implementing proper management techniques, soil and water conservation

North Zone Experience: CAJAMARCA



South Zone Experience: Ayacucho

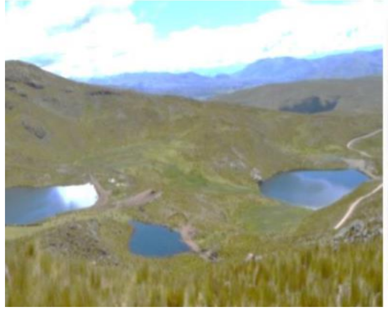
Ancestral practices of water management, recovered and converted into a communal activity

"YOU DON´T HARVEST WHAT YOU DIDN´T SEED"

South Zone Experience: Ayacucho

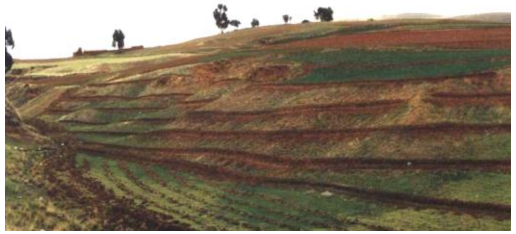
Resultados obtenidos: Disponibilidad de agua superficial

Results obtained:
Availability of superficial water.
Trout breeding and biodiversity recovery
(flora and fauna).



Resultados obtenidos: Disponibilidiad de agua superficial, crianza de truchas y recuperación de biodiversidad (fauna y flkora)

Central Zone Experience: Junín - Fundo La Cosecha del Futuro (“Harvest of the Future“).



Prior delimitation of areas for greater use skills, with the massive opening of infiltration ditches and the construction of platforms, to contour lines and using chaquitakllla (standing plow), to retain the rainwater and put an end to the erosion of the soils.

Peasants from the neighboring communities hired to develop the project, using the chaquitaklla. .

Central Zone Experience: Junín
Fundo La Cosecha del Futuro (“Harvest of the Future“).

In the steepest and poorest spaces, thousands of holes were opened to establish arboreal and shrub species, mainly native, as well as pastures. In addition, to recover the fertility of some soils, agricultural land was taken from the future lagoon..

Central Zone Experience: Junín
Fundo La Cosecha del Futuro (“Harvest of the Future“).

Demonstrating the advantages of the agroforestry system to retain rainwater and develop organic crops, avoiding water erosion, which allow greater fertility to improve agricultural production.

ESCUELAS VIVAS (“School alive”) in conservation works to retain rainwater, develop agroforestry and agropastoral systems, ennoble the environment and enable tourism (ecological and experiential) in the high Andes

Central Zone Experience: Junín
Fundo La Cosecha del Futuro (“Harvest of the Future“).

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YEAR 2,017

In year 2,000:
Dry and stony, mostly eroded, with some dying grasslands, which were also burned by peasants

Central Zone Experience: Junín
Fundo La Cosecha del Futuro (“Harvest of the Future“).

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INFLUENCE OF "THE HARVEST OF THE FUTURE" IN THE ECOSYSTEM

Appearance of seven growing oases at the foot of the estate, where before there was not a drop of water.

Water availability for animals, irrigation and -even- conquest of new productive spaces.

Appearance of wild species for recreation and study.

Accumulation of silt to fertilize land.

New ecological scenarios created by man.

Ministerio de Agricultura y Riego

PERÚ

Thank you very much.....

• *"From the sky comes the blessing of the rains, on earth is the creative capacity of man to multiply that blessing"*

César Dávila Véliz

www.sierraazul.gob.pe
Av. Salaverry 1388, Jesús María – Lima
(51) 01 3998077

Gabriel Selles, National Institute of Agriculture Research (INIA), Ministry of Agriculture of Chile. Presentation: Irrigation management strategy against the Climate Change

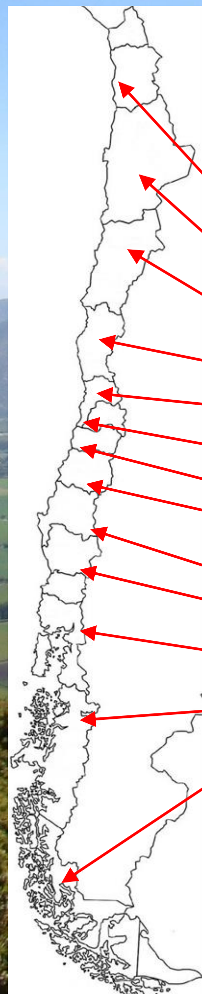
“Irrigation Management Strategys against Climate Change”

Gabriel Selles van Schouwen
Ing. Agrónomo Dr

Ministerio de Agricultura
Gobierno de Chile

INIA

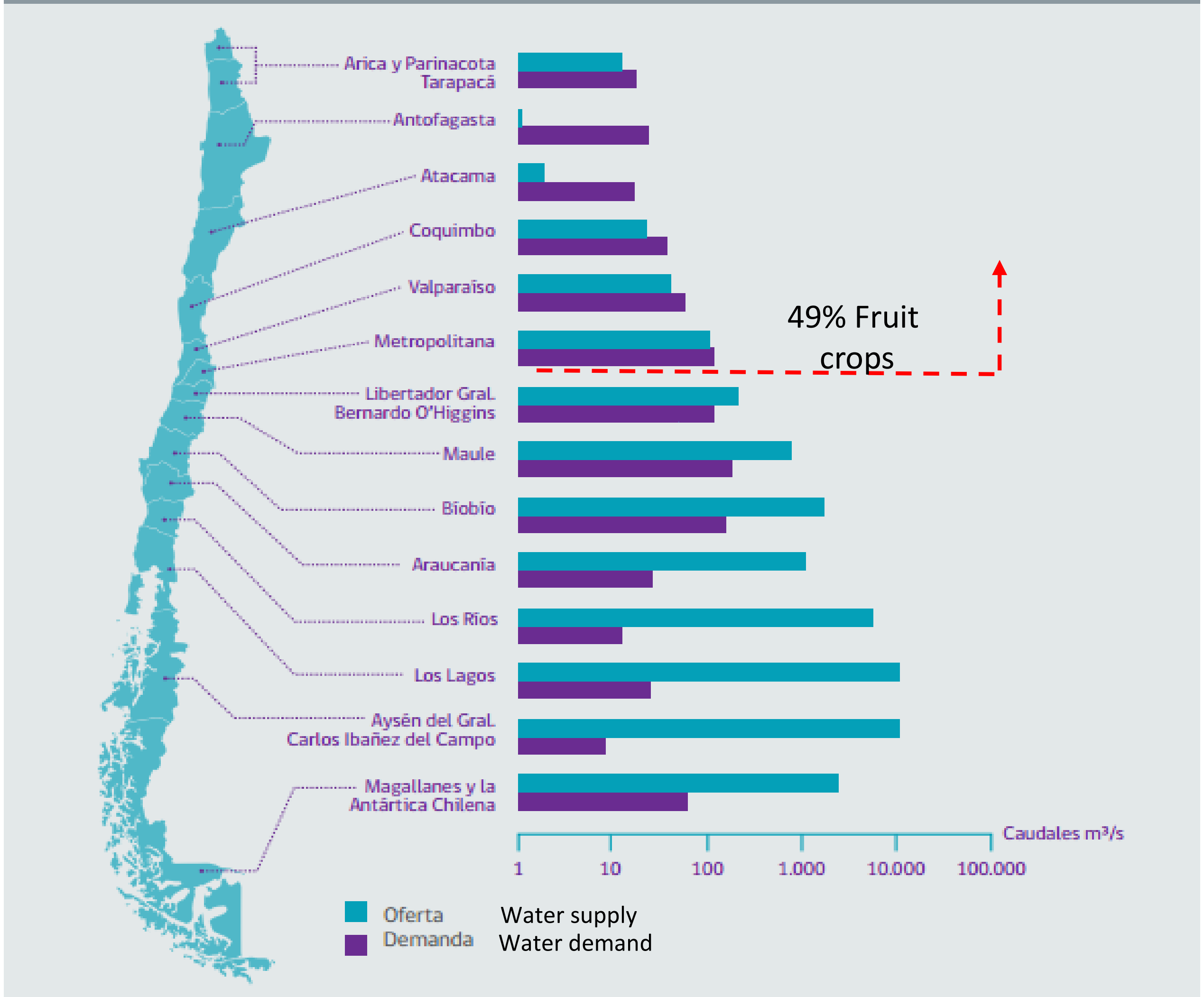
Agricultural land: 5.000.000 hás
Irrigated land : 1.100.000 hás
Fruit crops :285.700 hás



REGION	SUPERFICIE REGADA (Hás)	SUPERFICIE FRUTALES** (Hás)	% Acumulado
ARICA-PARINACOTA	12.301		
ANTOFAGASTA	2.294		
ATACAMA	19.354	10.794	4
COQUIMBO	75.714	29.863	14
VALAPARAISO	86.157	50.855	32
METROPOLITANA	136.757	48.063	49
O´HIGGINS	210.693	75.239	75
MAULE	299.102	48.28	92
BIO-BIO	166.574	11.231	96
ARAUCANIA	49.772	7.302	99
LOS RIOS-LOS LAGOS	12.535	4.073	100
AYSEN	2.717		
MAGALLANES	19.844		
TOTAL	1093814	285700	
Fuente (*) Censo 2006/07		(26%)	
(**) CIREN 2012			

National Water Balance

Figura 2. Disponibilidad y extracción del recurso por regiones.

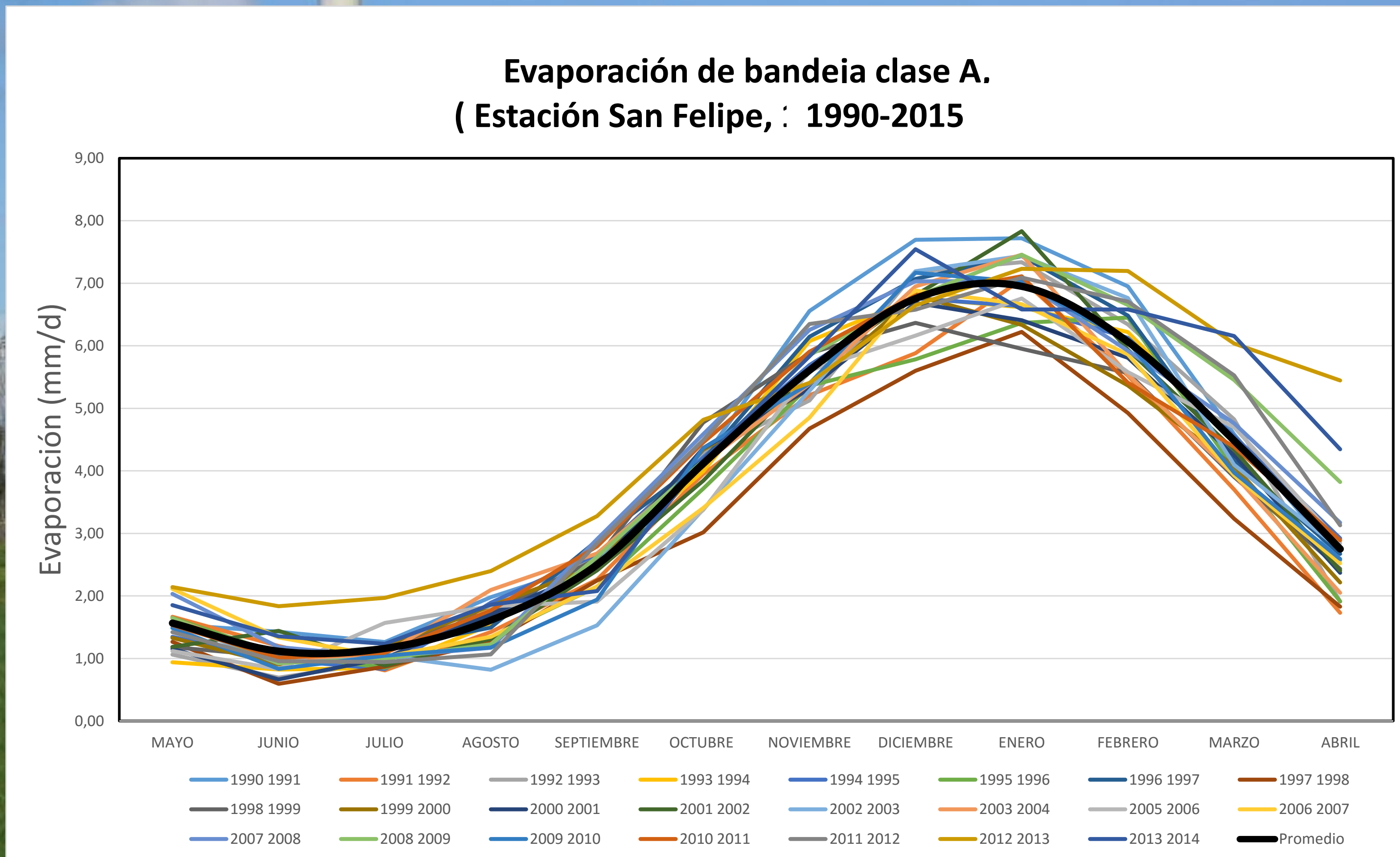


Fuente: Ministerio del Medio Ambiente, 2011. Informe del estado del medioambiente.

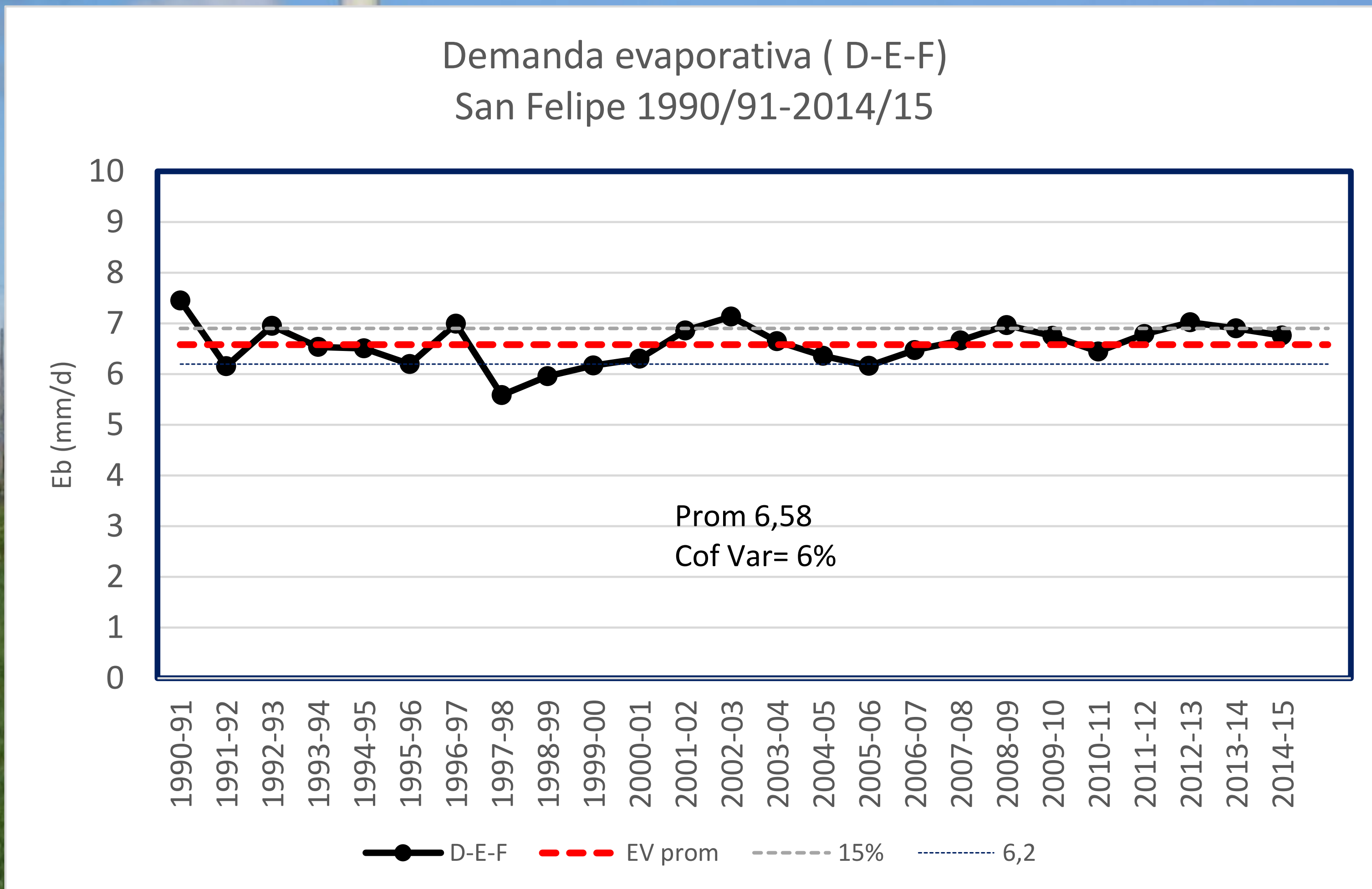
Droughts in Chile

Año(s)	Nombre	Regiones afectadas														
		AP	TA	AN	AT	CO	VS	RM	LI	ML	BI	AR	LR	LL	AI	MA
1924	Sequía de 1924					✓	✓	✓	✓	✓						
1933	Sequía de 1933				✓	✓										
1946	Sequía de 1946				✓	✓										
1955	Sequía de 1955					✓	✓	✓	✓	✓	✓	✓				
1960-1962	Sequía de 1960-1962					✓										
1964	Sequía de 1964					✓	✓									
1967	Sequía de 1967			✓	✓	✓	✓	✓								
1968-1969	Gran sequía de 1968[n 1]				✓	✓	✓	✓	✓	✓	✓					
1970-1971	Sequía de 1970-1971				✓	✓										
1979	Sequía de 1979										✓	✓	✓	✓		
1986	Sequía de 1986					✓										
1990-1991	Sequía de 1990-1991				✓	✓	✓									
1996	Sequía de 1996				✓	✓	✓	✓								
1998-1999	Sequía de 1998-1999				✓	✓	✓	✓	✓	✓	✓	✓				
2007-2008	Sequía de 2007-2008				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
2010-2011	Sequía de 2010-2011				✓	✓	✓	✓	✓							
2012-2015[6][7]	Sequía de 2012[8] -2015					✓	✓	✓	✓	✓	✓	✓				

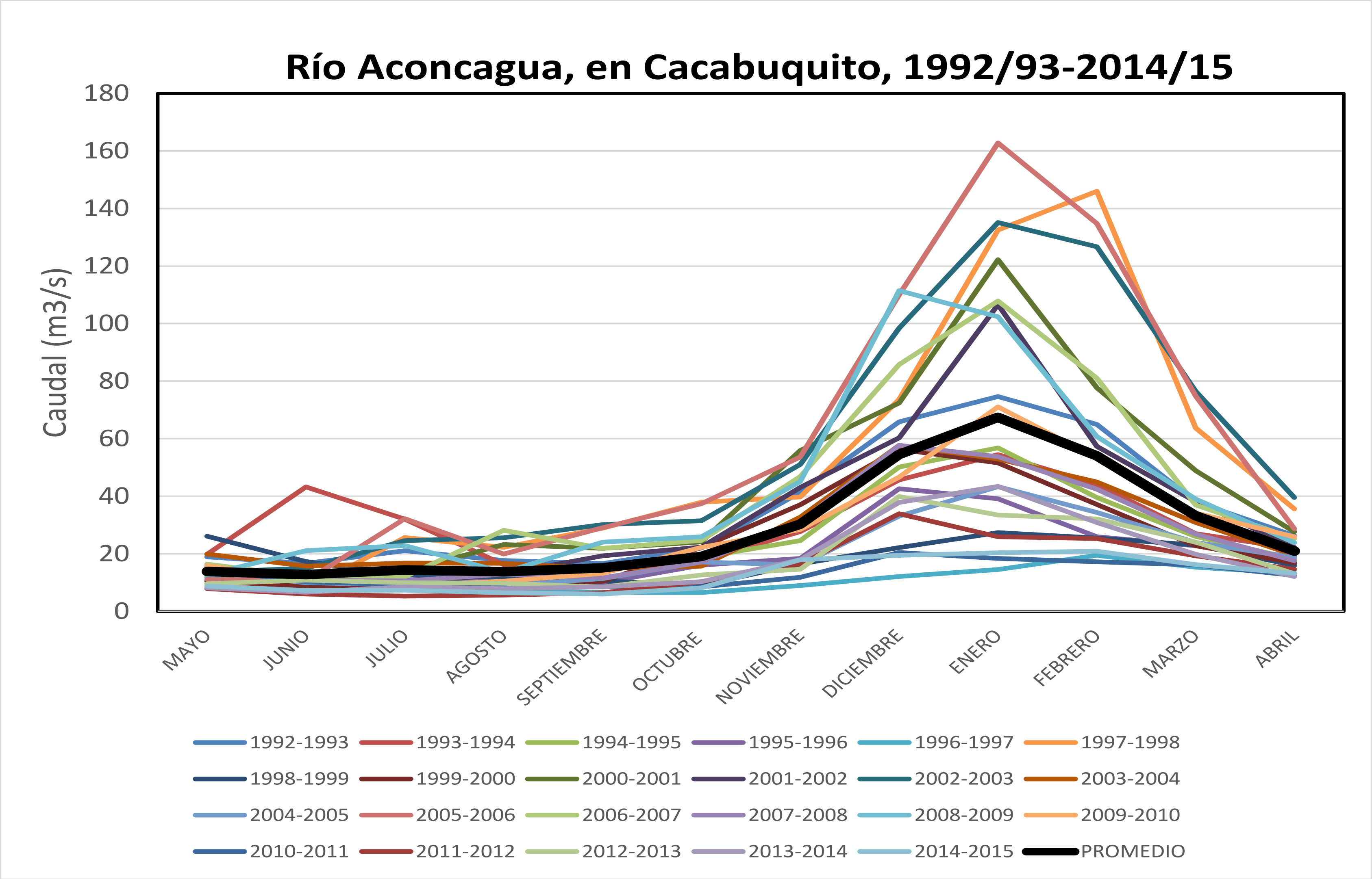
Variability of Water demand in the Aconcagua Valley (1990-2015



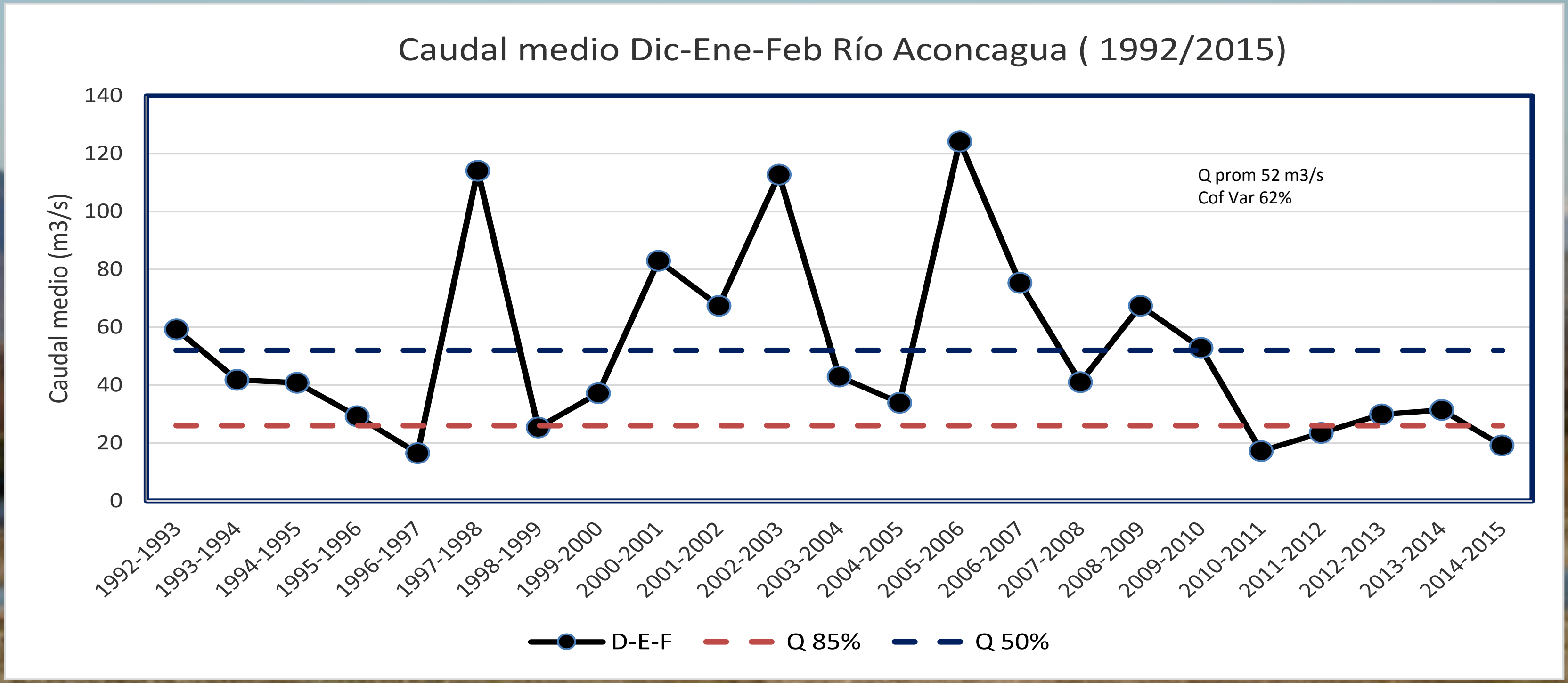
Variability of Water demand in the Aconcagua Valley
Average of December, January and February (1990-2015

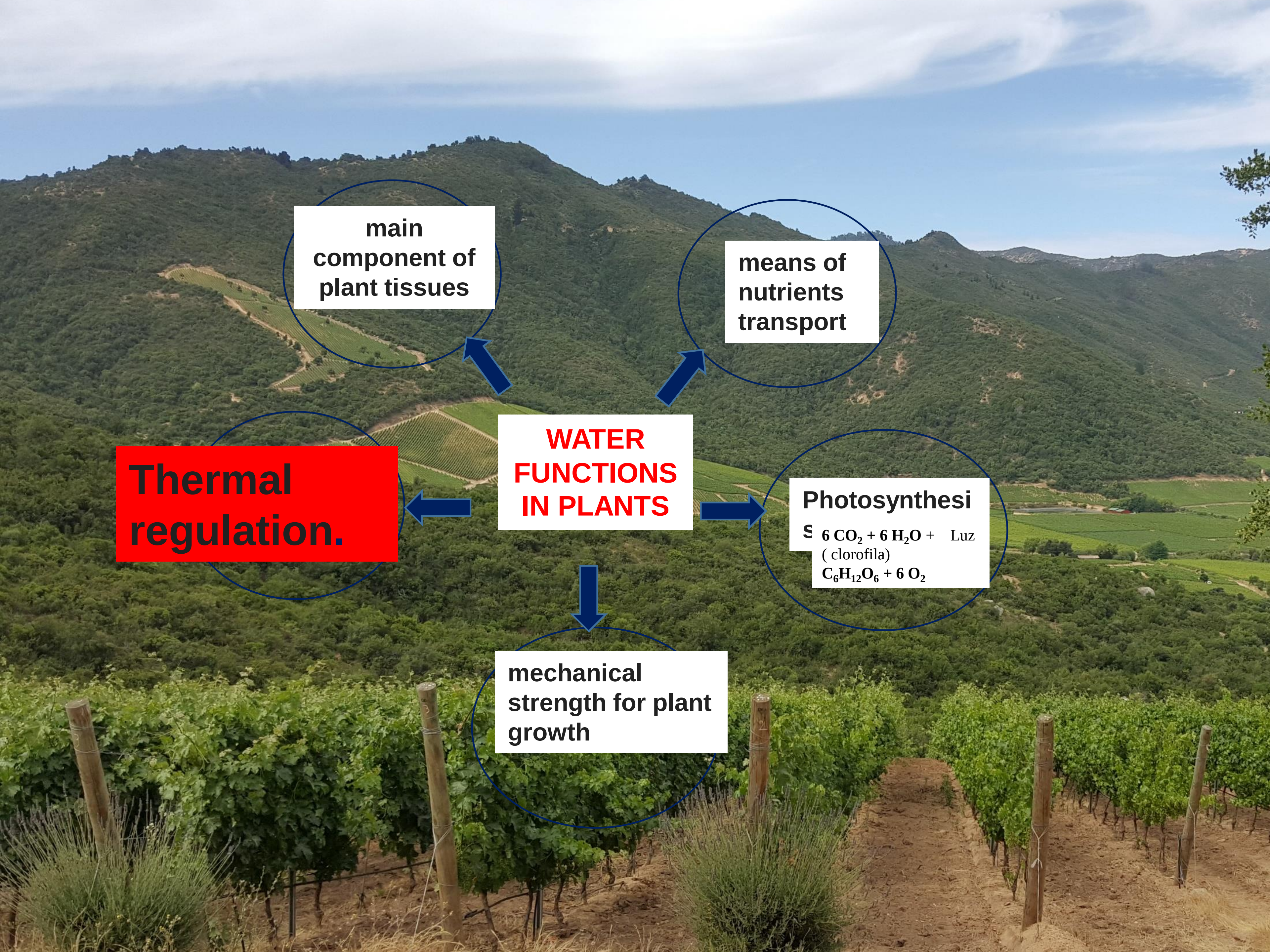


Variability of Water supply in the Aconcagua river (1990-2015)
(not regulated)

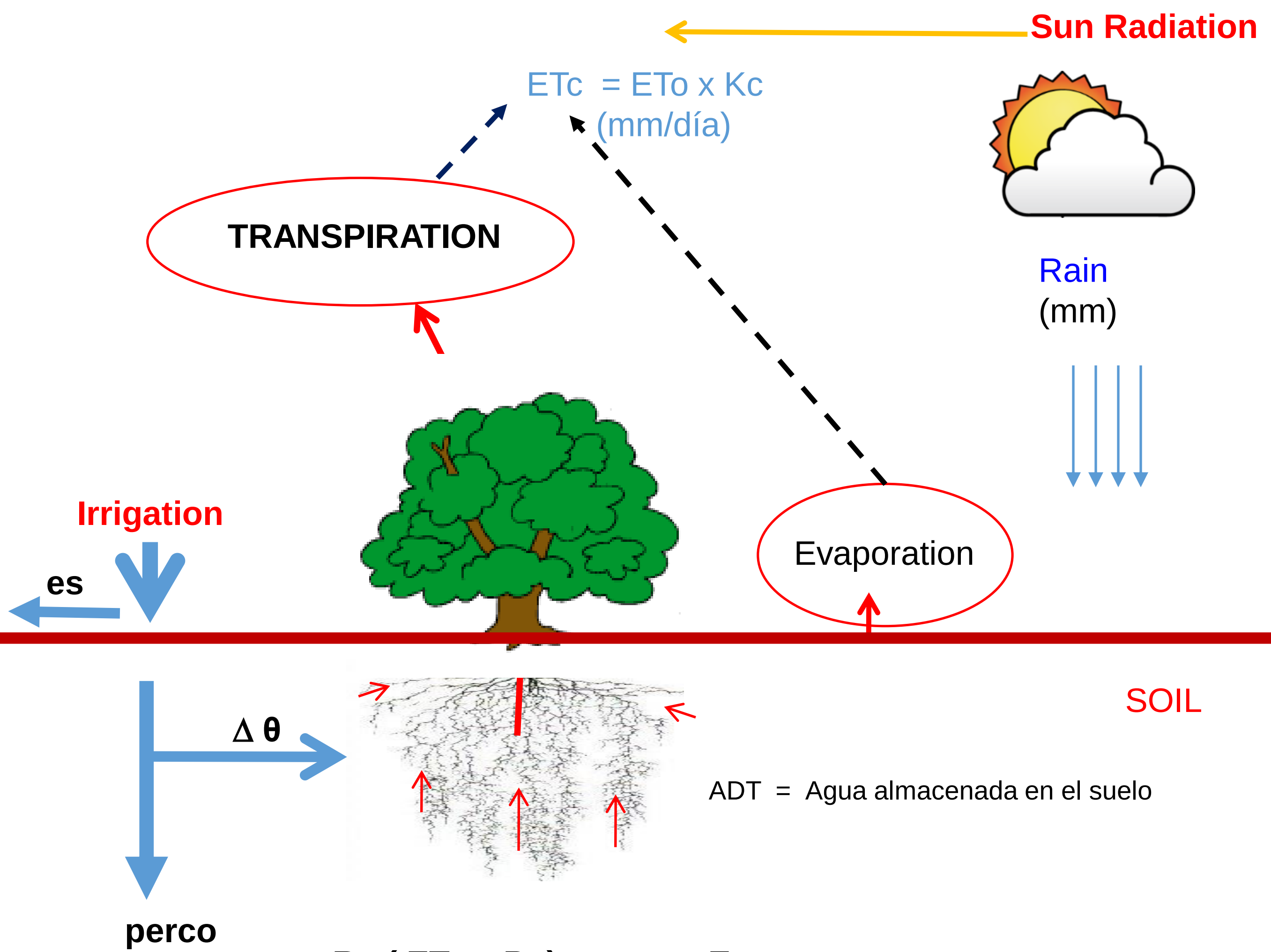


Variability of Water Supply Aconcagua river
Average of December, January and February (1990-2015



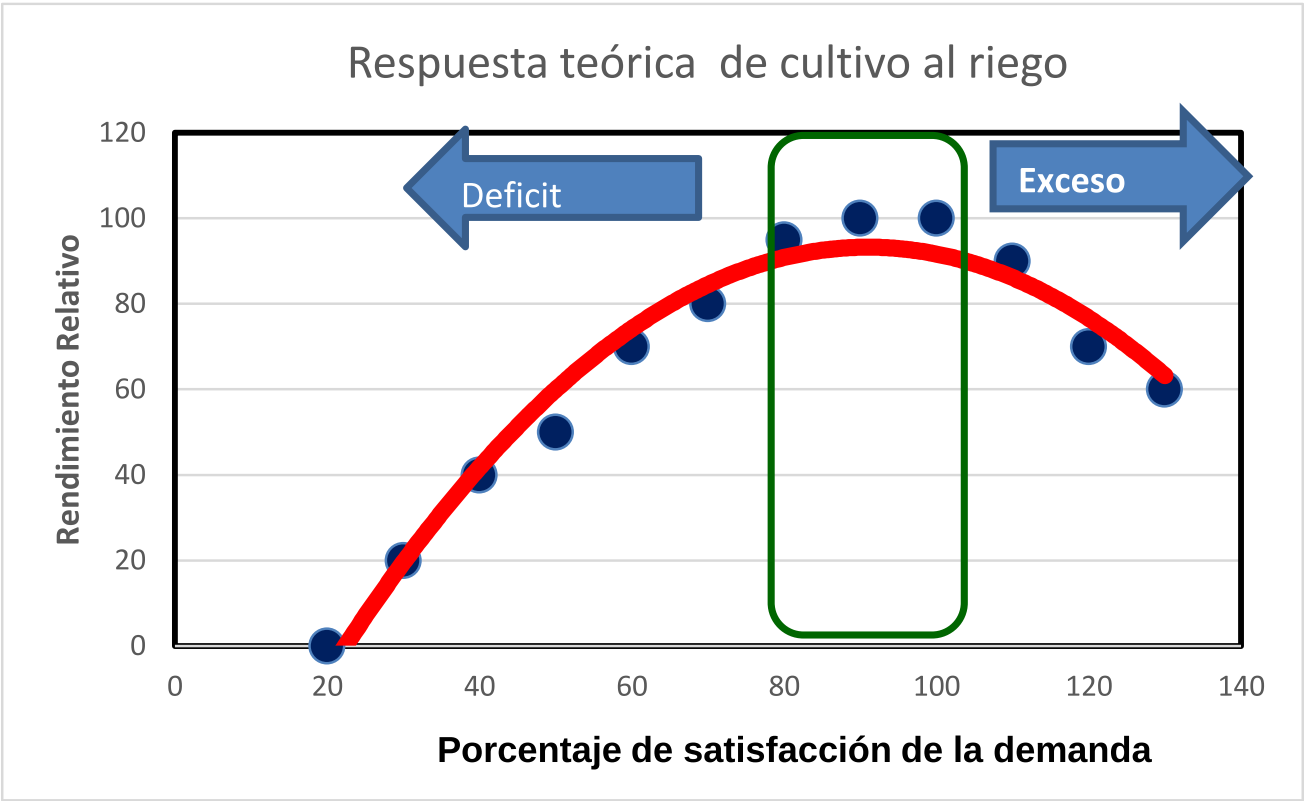

WATER FUNCTIONS IN PLANTS
main component of plant tissues
means of nutrients transport
Thermal regulation.
Photosynthesis
$6\ CO_2 + 6\ H_2O +$ Luz (clorofila) $C_6H_{12}O_6 + 6\ O_2$
mechanical strength for plant growth

Water balance



R =(ETc – Pp) + perco+Esup

Theoretical plant response to water supply



Relative yield (%)

Relative supply (ETa/Etc) %

REQUERIMIENTOS HIDRICOS

WATER REQUIREMENTS

$$RH = (\underbrace{ETc}_{\mathbf{E + Tc}} - Pef) + \boxed{Perco + Esup}$$

Irrigation efficiency

ETc = crop evapotranspiration(mm)

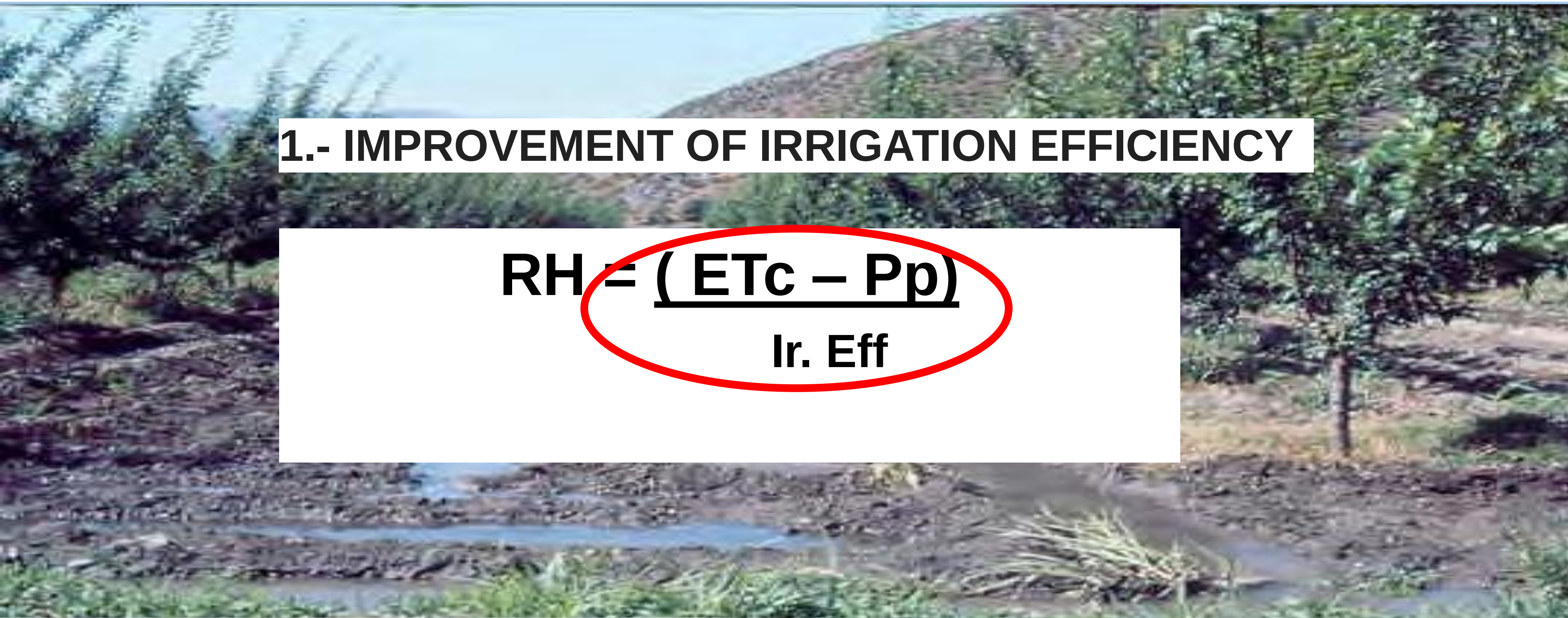
Pef = effective rainfall (mm)

Perco = Deep percolation

Esup = Surface run off

E = soil evaporation

Tc= crop transpiration



1.- IMPROVEMENT OF IRRIGATION EFFICIENCY

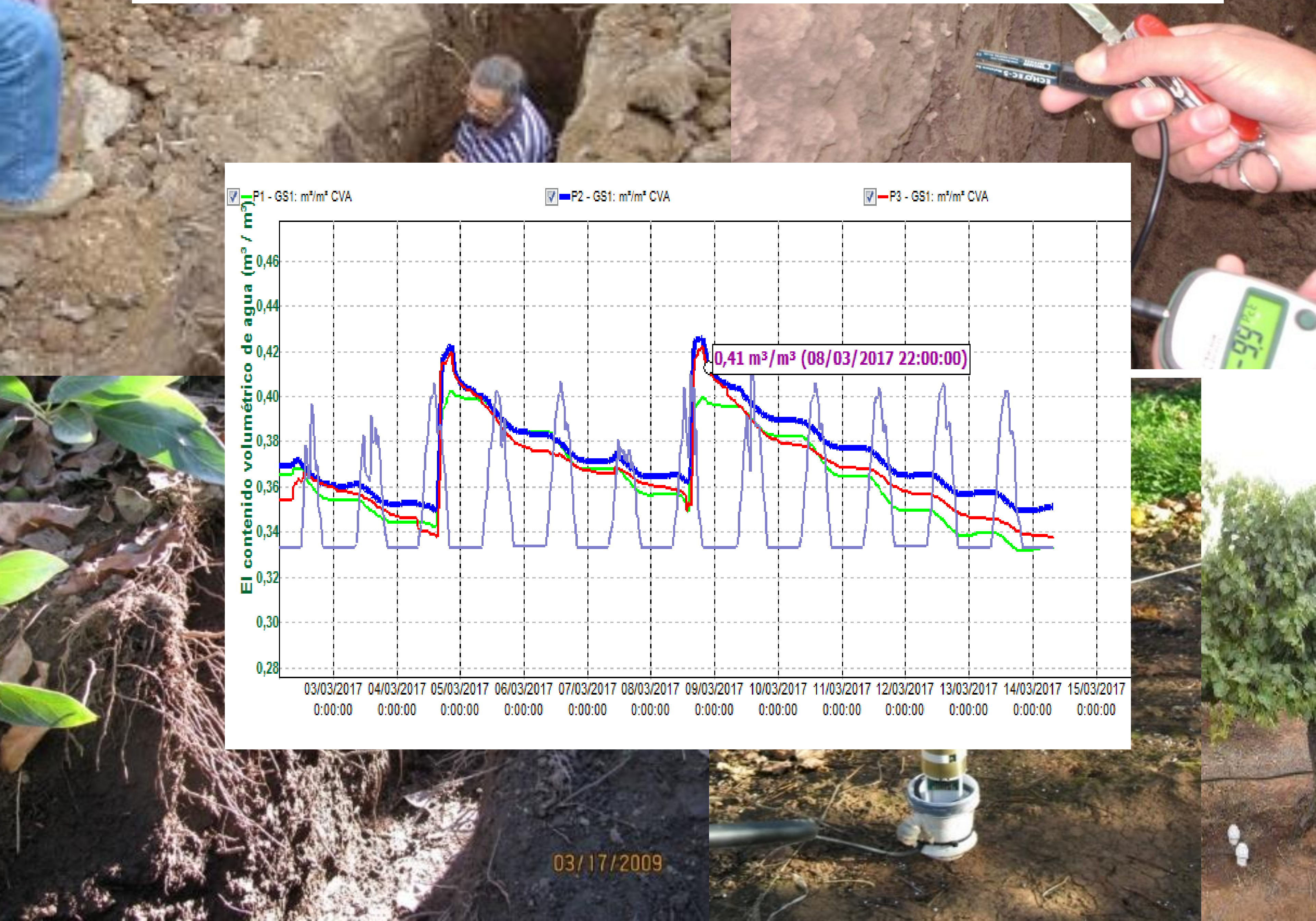
$$RH = \frac{(ETc - Pp)}{Ir.\ Eff}$$

Método de riego	Ef%
Tendido (Wild irrigation)	30
Surco (furrow)	45
Aspersión (sprinkler)	75
Microaspersión (micro sprinkler)	85
Goteo (drip)	90

1.1.- MANTENCION DEL EQUIPO DE RIEGO
(EQUIPMENT MAINTENANCE)

- **Evaluación de caudales** **(Flow assessment)**
- **Control de presiones** **(Pressure control)**
- **Lavado de líneas** **(Lines flushed)**
- **Mantención de filtros** **(Filter cleaning)**
- **Mantención de bombas** **(Pump maintenance)**

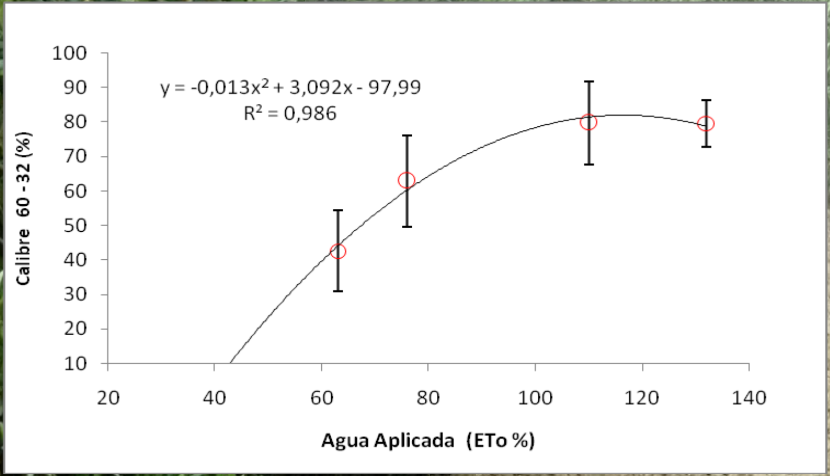
1.2.- PROGRAMACIÓN Y CONTROL DE RIEGO



2. –ESTRATEGIA PARA REDUCIR EL CONSUMO DE AGUA : Riego Deficitario (Eta< Etc)

2. –STRATEGIES FOR REDUCTIÓN FRUIT CROPS WATER USE: Deficit irrigation (Eta< Etc)

- **REGULATED DEFICIT IRRIGATION (RDI)**
- **SUSTAINED DEFICIT IRRIGATION(SDI)**



Avocado

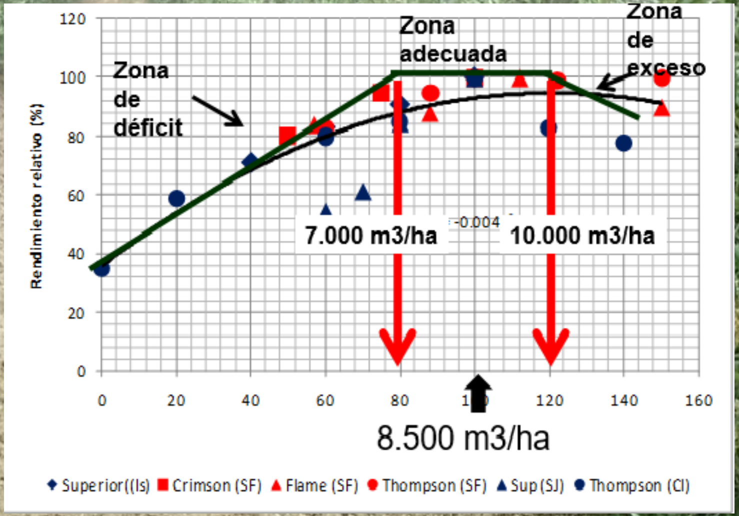
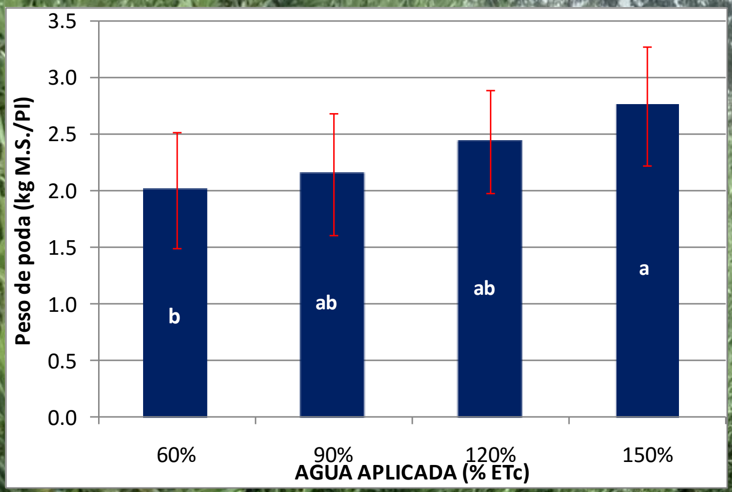


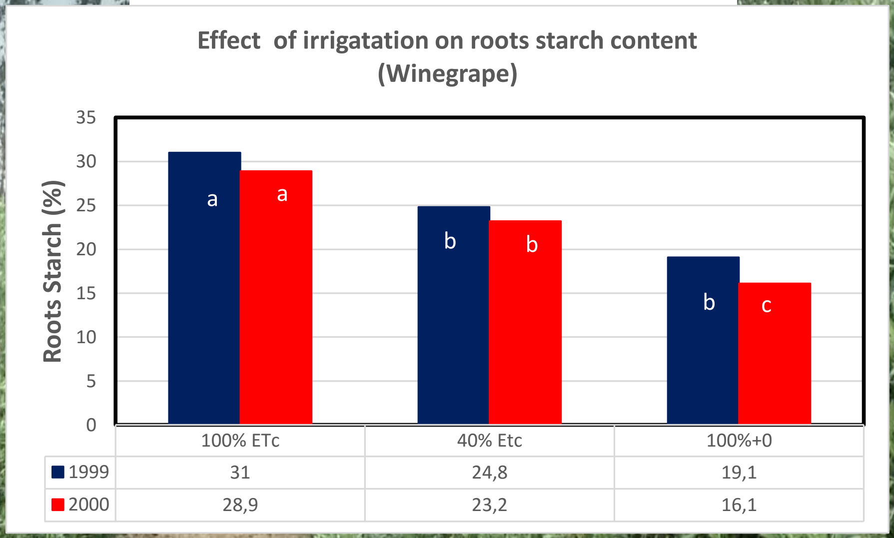
Table grape

RESPUESTA EN EL MEDIANO Y CORTO PLAZO
(MEDIUM AND LONG-TERM RESPONSE)

PESO DE PODA cv THOMPSON S
(Prunning weight in tablegrape).



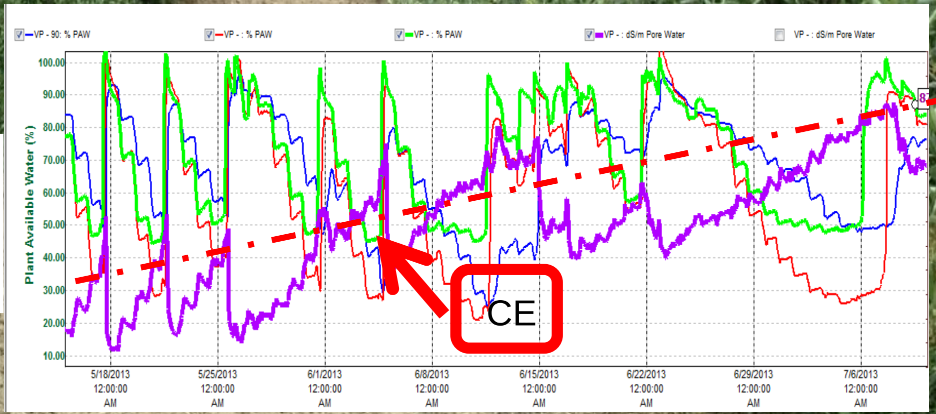
RESERVA NUTRICIONAL RAICES
(Roots nutritional reserves)



	100% ETc	40% Etc	100%+0
1999	31	24,8	19,1
2000	28,9	23,2	16,1

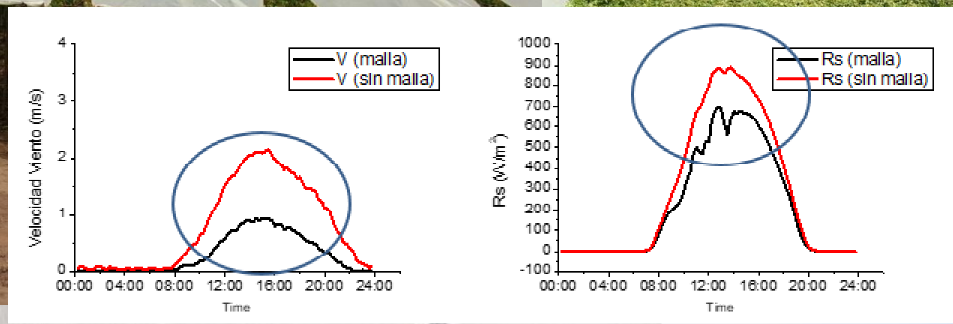
ACUMULACION DE SALES EN ZONA DE RAICES
(Salts accumulation in root zones)

(CE = Cond. Eléctrica)



3. –ESTRATEGIA PARA REDUCIR EL CONSUMO DE AGUA
Modificaciones Microclimaticas : cobertores de mallas y plástico

3. –STRATEGIES FOR REDUCTION FRUIT CROPS WATER USE
Microclimatic modification :Nets and plastic covers



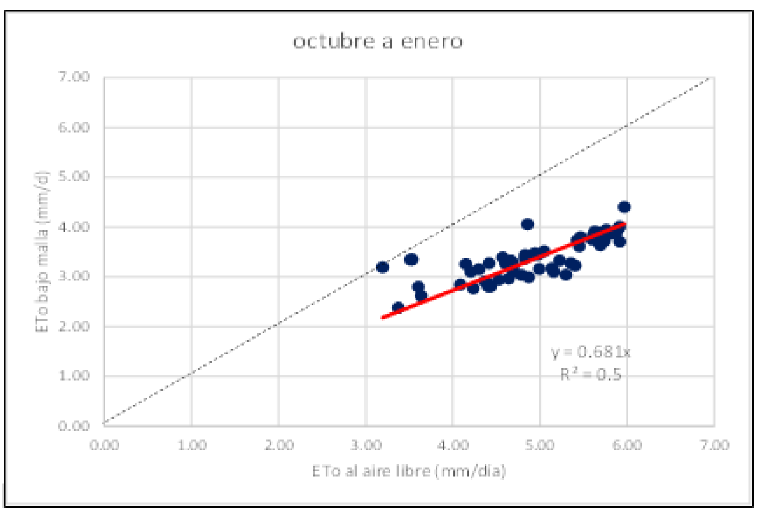


Figura 3. Evapotranspiración de referencia (ETo) al aire libre y bajo malla.

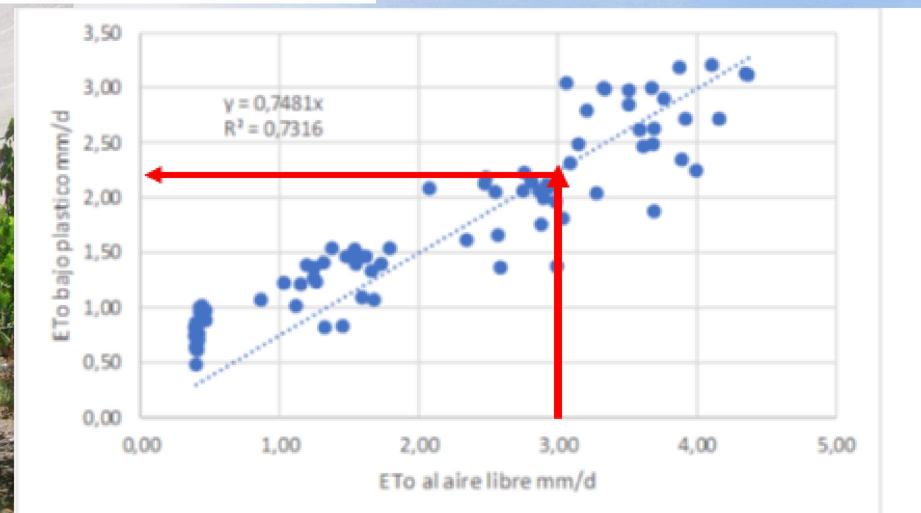


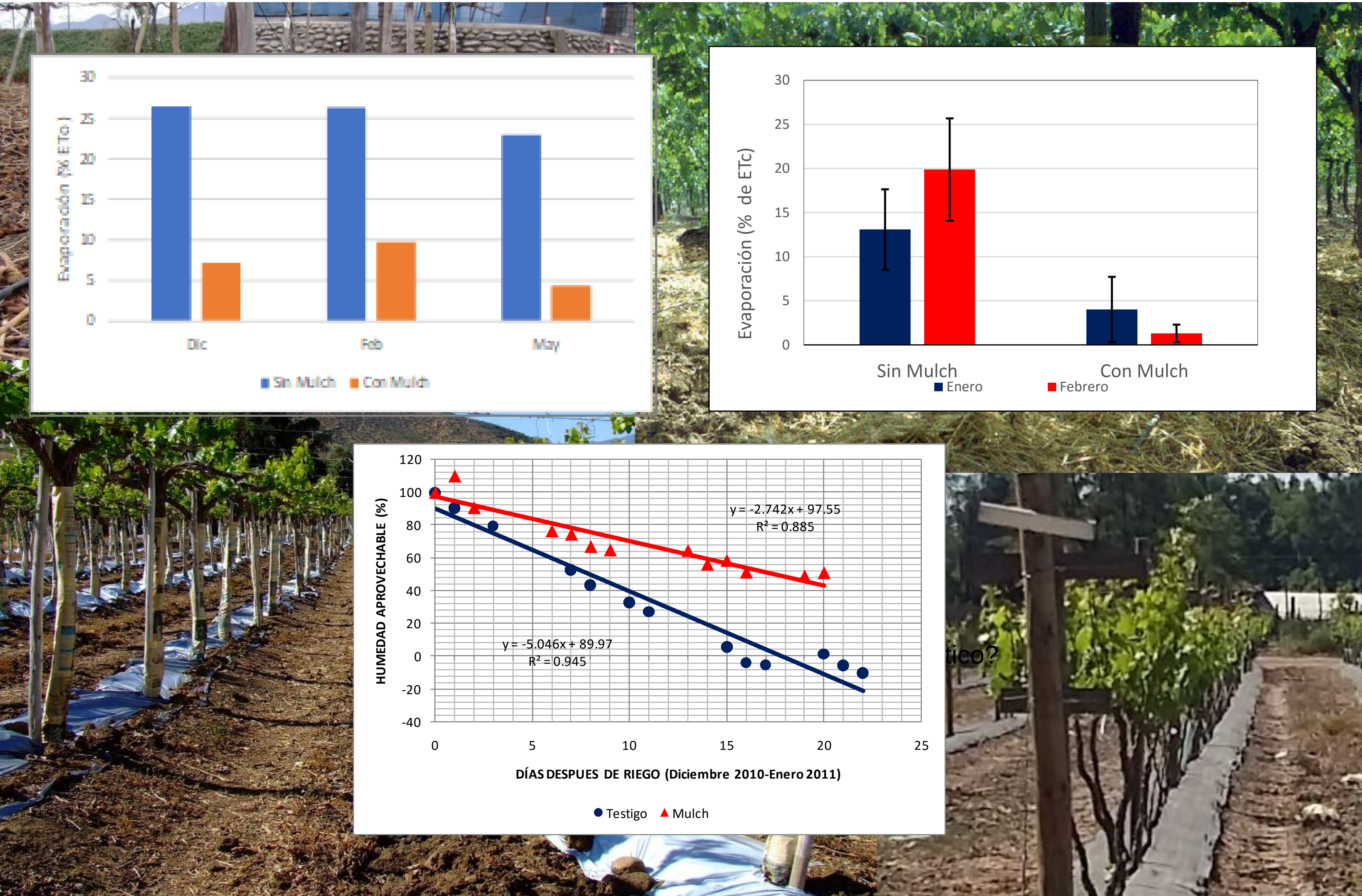
Figura 17 Efecto de la cubierta de plástico en la demanda atmosférica (Evapotranspiración de referencia ETo)

4. –ESTRATEGIA PARA REDUCIR EVAPORACION DEL SUELO (Mulch)

4. –STRATEGIES FOR REDUCTION SOIL EVAPORATION (Mulching)

evaporación directa de agua del suelo en un parronal

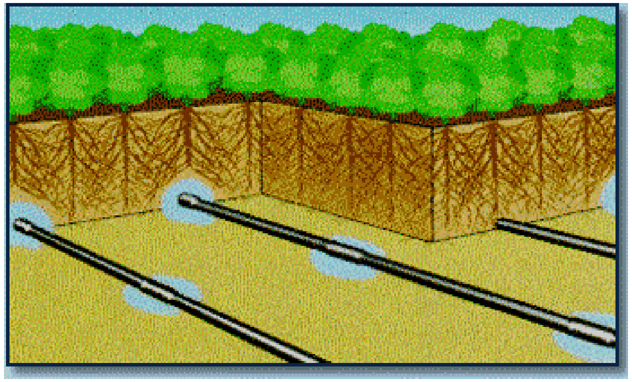
Mes	mm/día	m3/ha/mes	% de ETc
nov	1,68	504	37
dic	1,15	356,5	24
ener	1,89	585,9	36
feb	1,83	512,4	27
Promedio			31



Evaporación (% ETo)
Dic
Feb
May
Sin Mulch
Con Mulch
Evaporación (% de ETc)
Sin Mulch
Con Mulch
Enero
Febrero
HUMEDAD APROVECHABLE (%)
DÍAS DESPUES DE RIEGO (Diciembre 2010-Enero 2011)
y = -2.742x + 97.55
R² = 0.885
y = -5.046x + 89.97
R² = 0.945
Testigo
Mulch
tico?

4. –ESTRATEGIA PARA REDUCIR EVAPORACION DEL SUELO (Riego Subsuperficial)

4. –STRATEGIES FOR REDUCCIÓN SOIL EVAPORATION (Sub Surface irrigation)

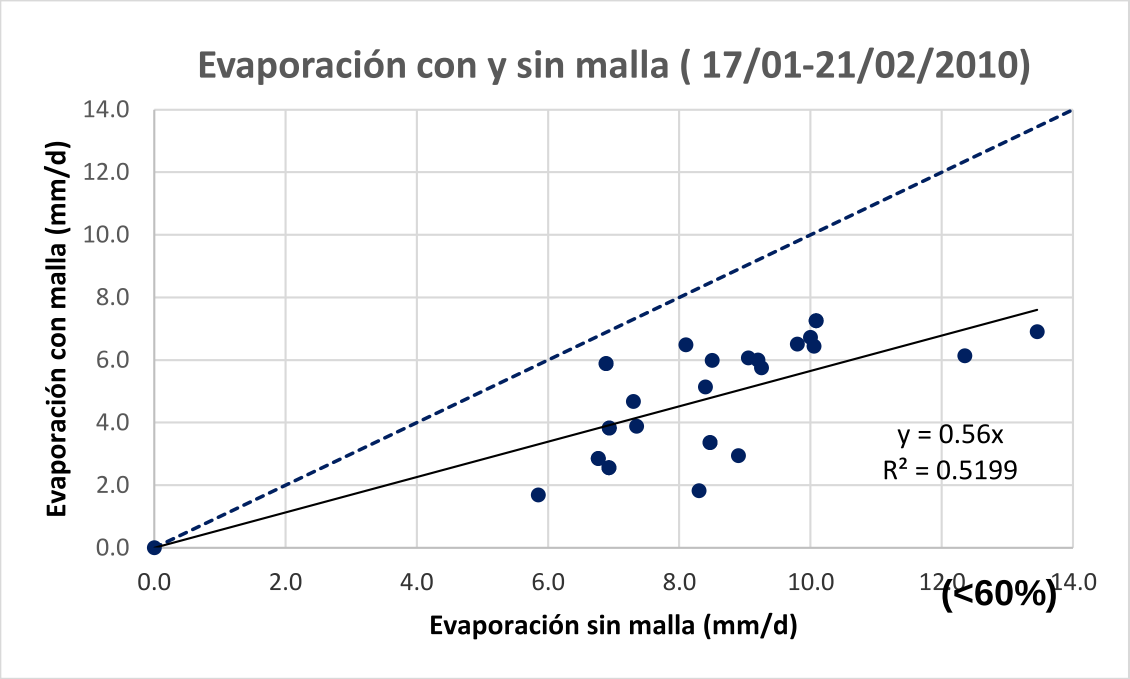


Según literatura
Permitiría ahorros
de hasta un 40% de agua
Línea de trabajo incipiente
en el grupo INIA

According to literature
It would allow savings up
to 40% water
Incipient research line
in the INIA group

5.- Reducción de evaporación en tranques

5.- Reduction of evaporation losses from water reservoirs



Grupo de trabajo en manejo de riego
INIA- Centro -Norte

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Liu Jing, IAED - Chinese Academy of Agricultural Sciences (CAAS), China. Presentation: Farmer adapt to Climate Change in China: an agricultural technology perspective

中国农业科学院农业经济与发展研究所
INSTITUTE OF AGRICULTURAL ECONOMICS AND DEVELOPMENT, CAAS
IAED

Best Practices Adapt to Climate Change Related to Water for Smallholder in China

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心 耕 学 海　唯 是 求 新　Santiago, Chile , Nov 29,2017

Rationale

- North China face the severe water shortage issue
- Climate change will affect both water availability and accessibility
- Need for better understanding of
  - Impacts of climate change on rural livelihoods
  - Appropriate adaptation
- Need to involve science, policy makers…
  …and rural communities

Evidence suggests climate change is already affecting water availability crop growth and rural livelihoods.

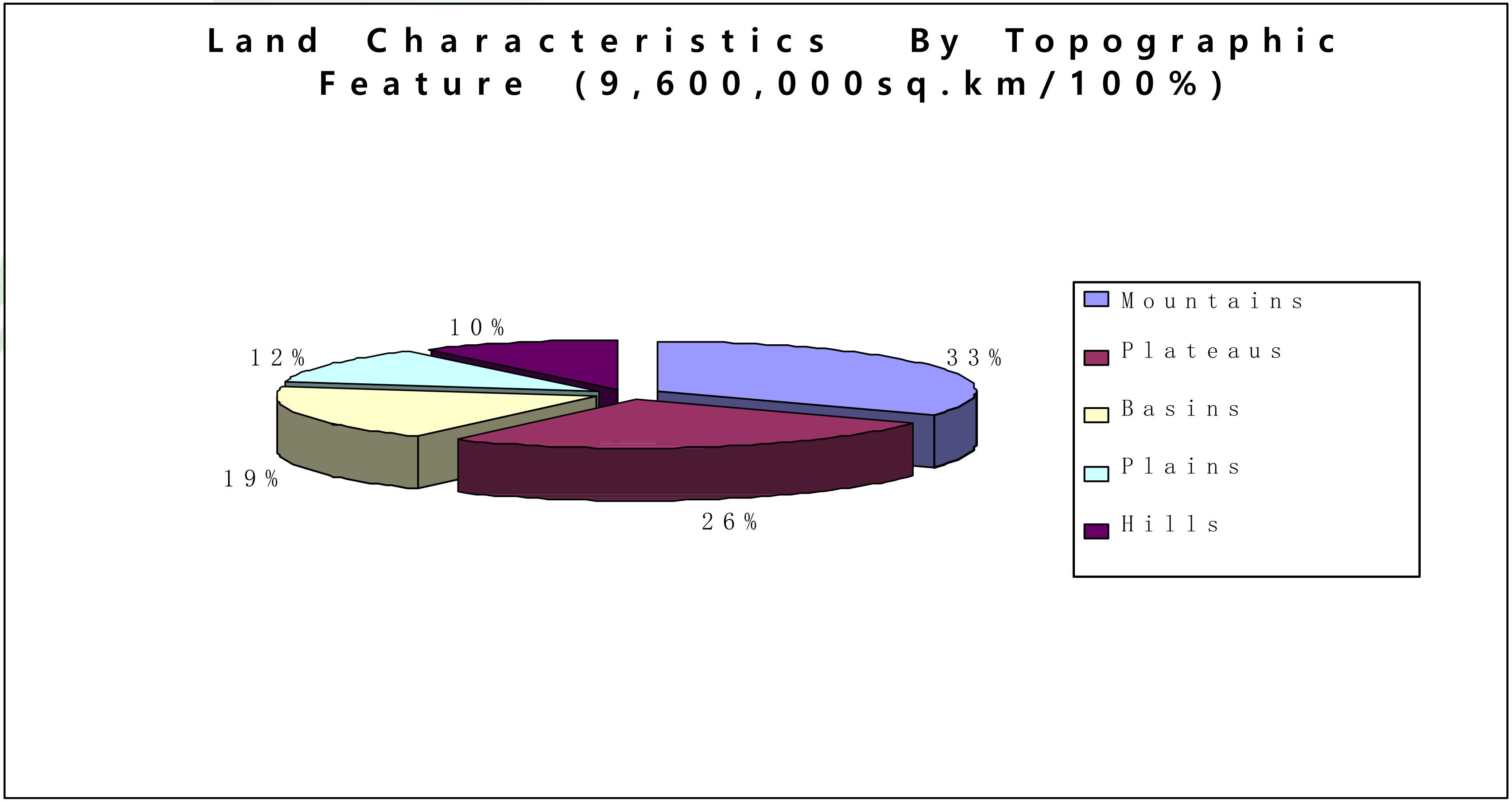
注：此图是从国家地理信息中心网站下载的标准画法示意图

Administrative regions:

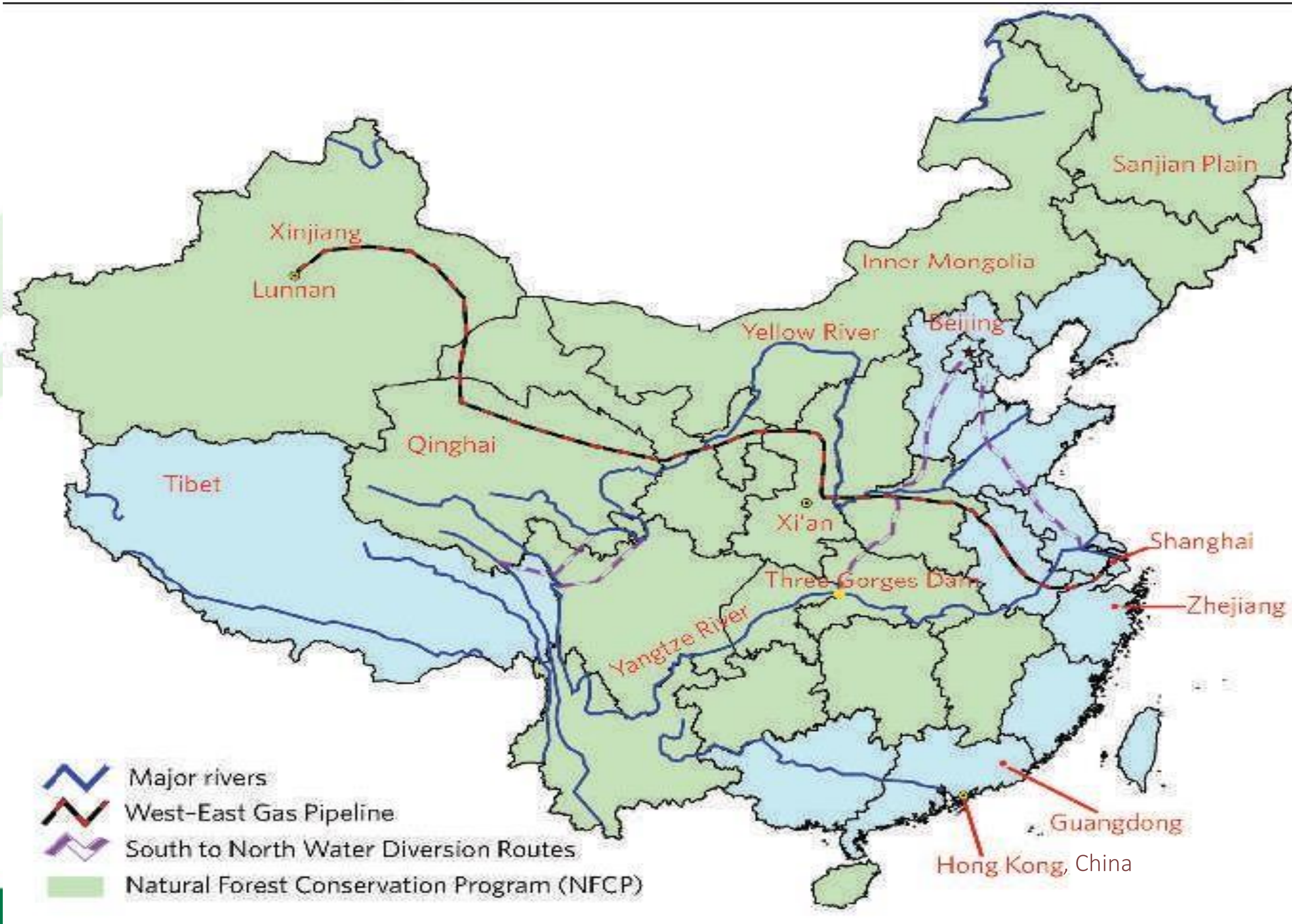
31 provinces, autonomous regions and municipalities (not including HKC,Macao and CT) 2861 counties

The number of total population is 1.370536875 Billion (till 2010.11.1 00:00am including Hong Kong China, Macao and Chinese Taipei)

Land Characteristics by Topographic Feature

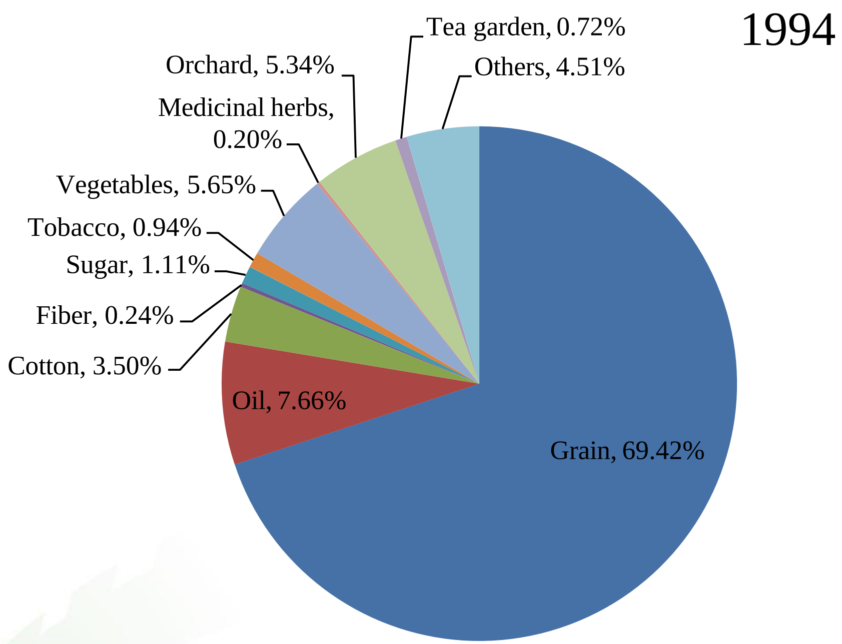


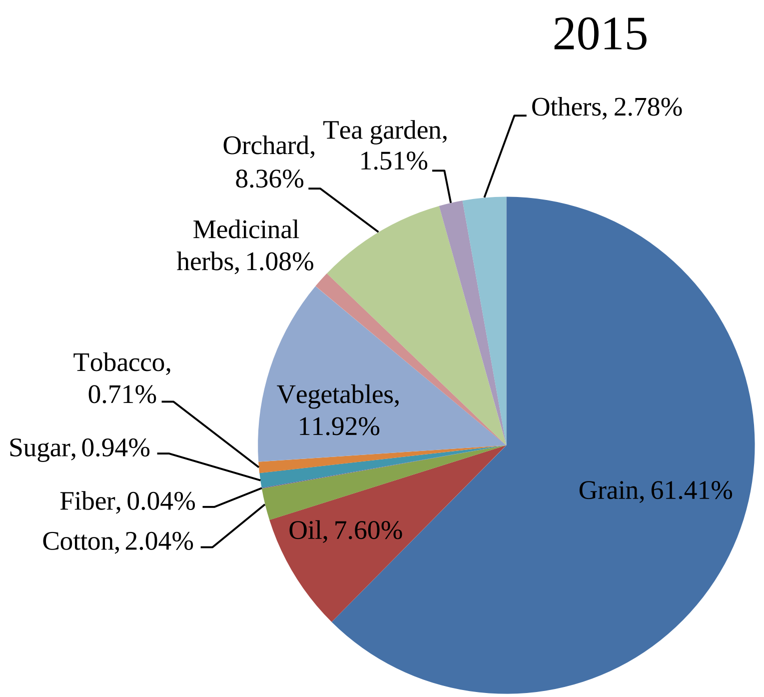
Water Distribution



Agricultural Characteristics in China

The percentage of sown area of major corps in 1994 and 20115





Data: China National Bureau of Statistics

Challenge to ensure food security in China

- The grain potential production capacity
  - Reduction arable land from 1995 to 2012 10 million ha arable land lost
  - Water scarcity
  - Rising labor cost
  - Climate Change
  - Environment protection non-point source pollution

Challenge to ensure food security in China

- The demand side
  - Income increase
  - Population increase annual net population increase 7 million
  - Migrant worker annual net increase migrant worker 5 million
  - Annual net increase food consumption 3.5-4 billion Kg

Drought and agricultural production

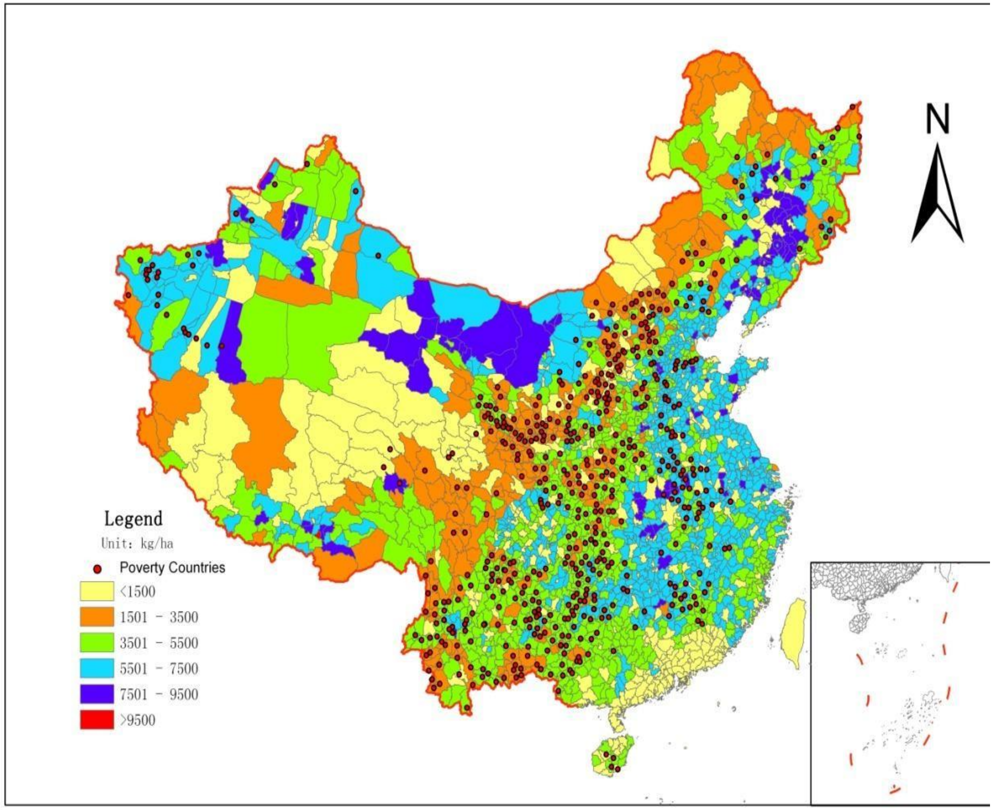
1950～2009 Drought Statistics in China

Year	Disaster-affected areas （1000 hectares）	Disaster areas （1000 hectares）	Crop failure areas （1000 hectares）	Grain loss （100 million kg）	Difficult to access drinking water （10,000 people）	Livestock difficult to access drinking water （10,000 heads））
1950-1980	18790.97	6731.26		75.16		
1981-2009	24805.28	12716.38	2739.55	252.88	2745.76	2139.14
1990-2009	24992.11	13182.10	2755.36	277.85	2745.76	2139.14
1950-2009	21697.89	9624.07	2739.55	161.06	2745.76	2139.14

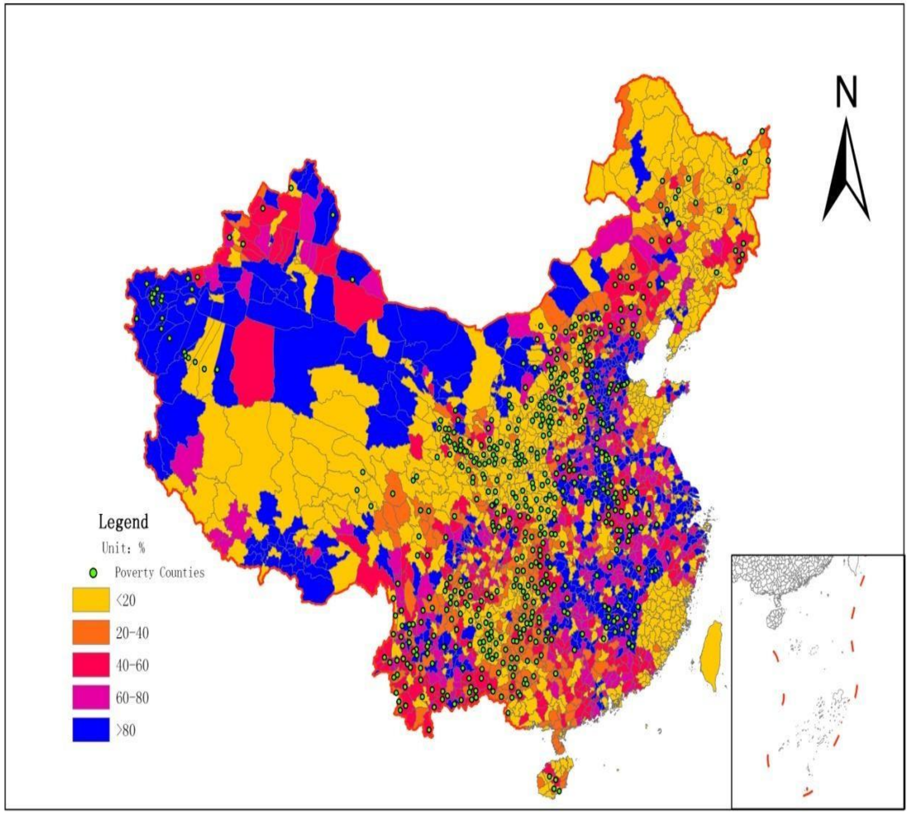
Source：Calculated according to 2009 China Flood and Drought Bulletin

The map of Grain yield and irrigation ratio

The distribution map of unit yield in Chinese counties in 2008



The irrigation level distribution in Chinese counties in 2008

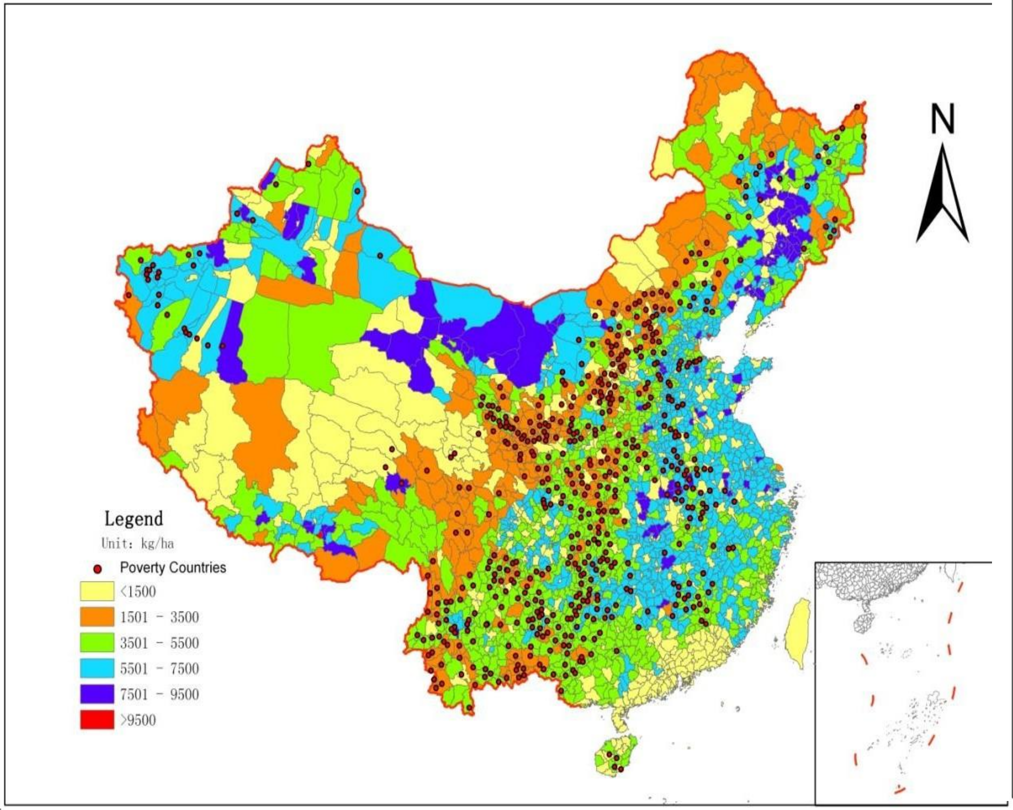


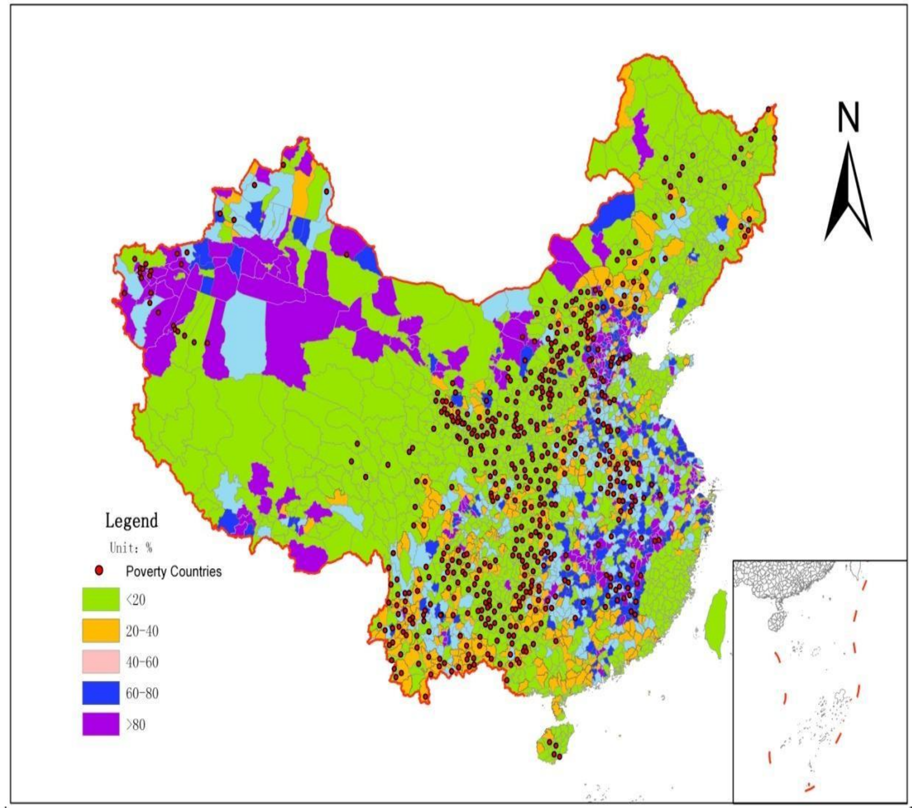
Data source: 2008 Agricultural Statistics Resources in Chinese Counties (Cities)
Cartographic software: ArcGIS 9.3

The map of Grain yield and stable-harvesting ratios

The distribution map of unit yield in Chinese counties in 2008

The stable-harvesting level distribution in Chinese counties in 2008





Data source: 2008 Agricultural Statistics Resources in Chinese Counties (Cities)
Cartographic software: ArcGIS 9.3

Results

- **10% lowest grain yield counties**
- **25% lowest grain yield counties**
- **Counties with the median grain yield**
- **75% highest grain yield counties**
- **10% highest grain yield counties**

Conclusion

- Firstly, under other input factors unchanged, in all quantile regression models, the contribution coefficients of unit yield by the irrigation ratio and the stable-harvesting ratio are the significant positive at 1%.
- Secondly, for the lowest unit yield group (10% lowest unit yield group), and 25 % lowest unit yield group, increase labor have the most significant influences on increasing grain unit yield.
- Thirdly, the contribution ratios to the unit yield made by the stable-harvesting ratio are higher than the irrigation ratios.

Policies and actions to Decelerate Climate Change in Ningxia Agricultural Sector

- Adjusting cropping systems
- Development livestock breeding
- Afforestation and control overgrazing
- Water-saving irrigation
- Strengthening the capacity of farmers
- Comprehensive methods

Farmers coping behavior to climate change

- Need for better understanding of
  - Impacts of climate change on rural livelihoods
  - Appropriate adaptation
- Need to involve science, policy makers…
  …and rural communities

Evidence suggests climate change is already affecting both crop growth and rural livelihoods.

Survey design

- Semi-structured questions
  - Livelihoods context (income, education, land assets...)
  - Perceptions of climate variability
  - Impacts on agricultural productivity/ Water access
  - Adaptive behaviour
  - Government support
- 6 survey villages 20 participants in each
  - Three agricultural zones
  - Poverty distribution
  - Existing agricultural data
  - Geographically accessible

Ningxia: location of the survey villages

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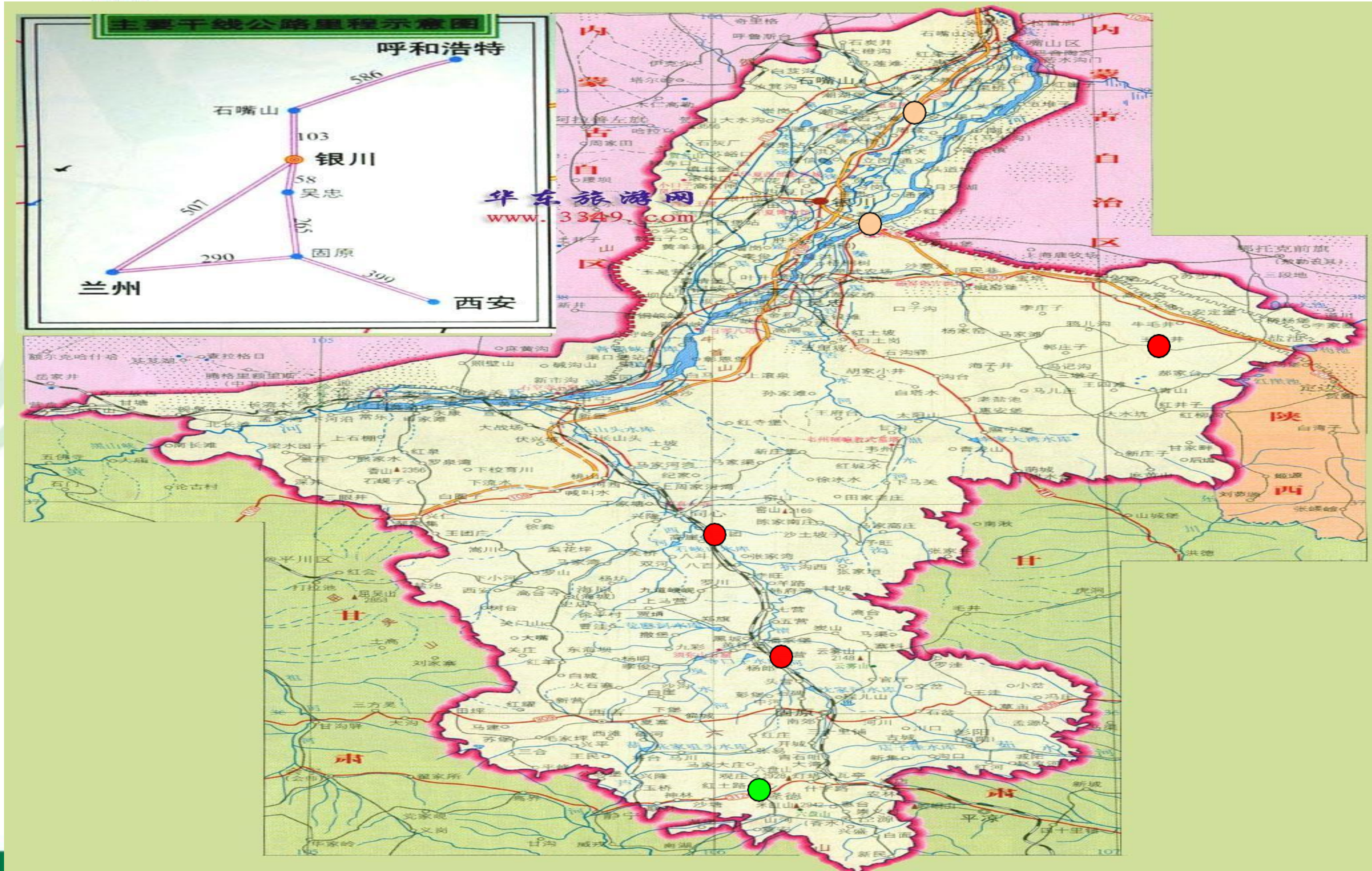
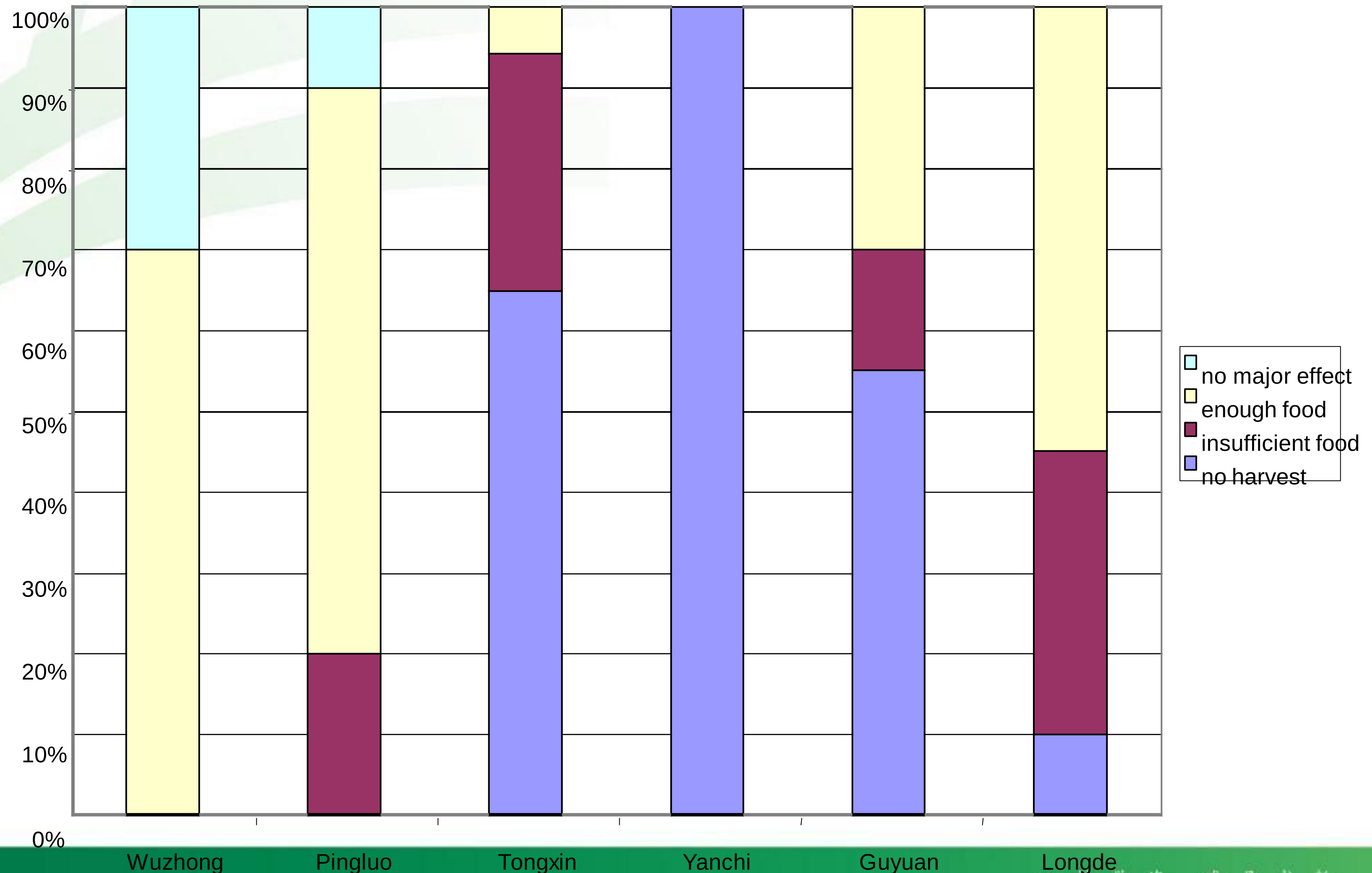


Impact of factors on family's agricultural income during the last 10 years

County name	Tax	Cereal Price	Planting Area	Disaster	Ability to sell	Price Feed	Fert. Price	Other
Wuzhong	9	**18**	12	**18**	2	2	**18**	0
Pingluo	9	**13**	4	**20**	3	14	**20**	0
Tongxin	0	**7**	6	**17**	8	3	**16**	0
Guyuan	4	**6**	10	**20**	7	3	**15**	1
Yanchi	2	**10**	1	**18**	9	3	**13**	0
Longde	2	**12**	5	**20**	8	1	**16**	0

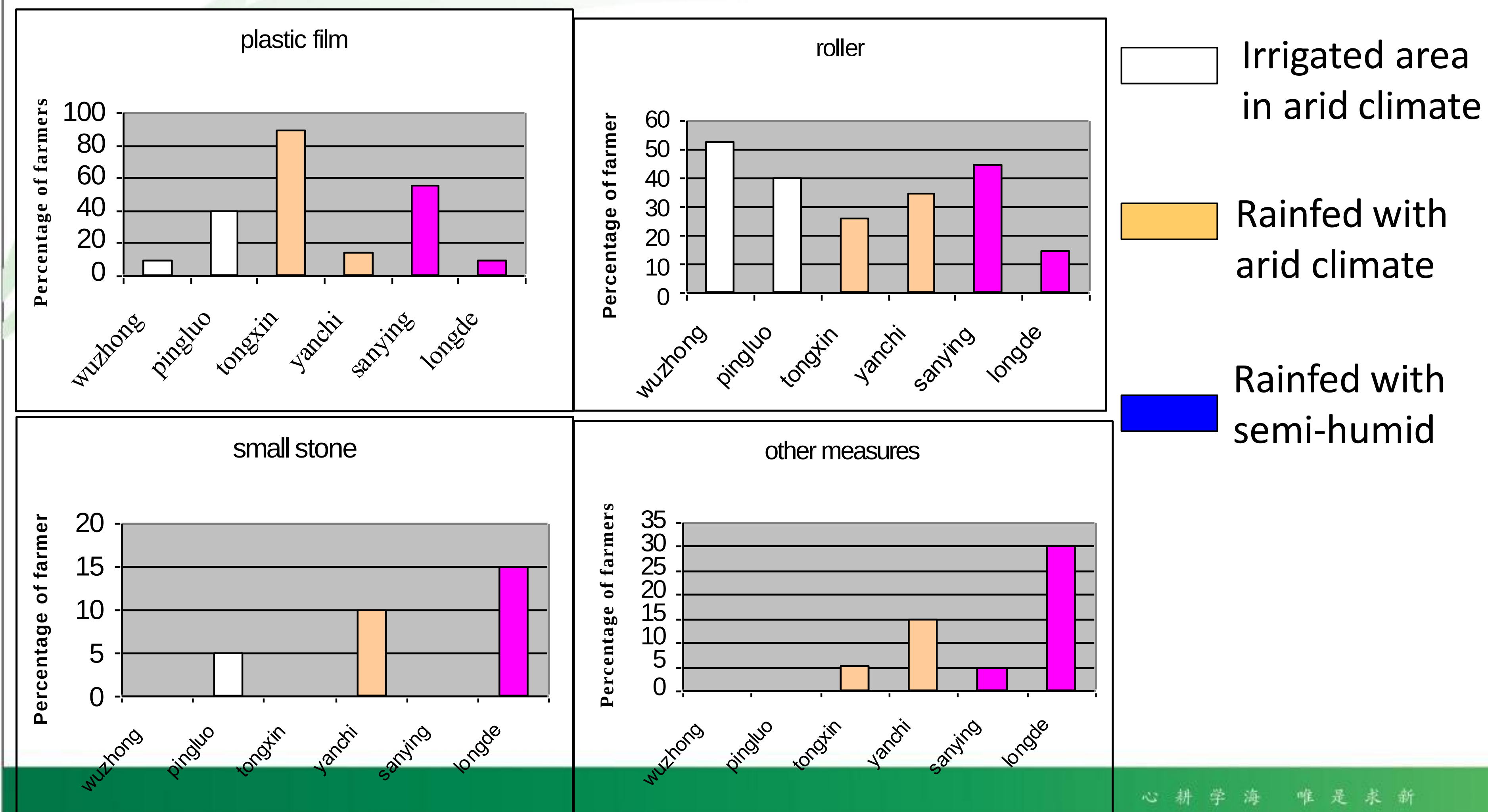
How seriously are families affected by drought?



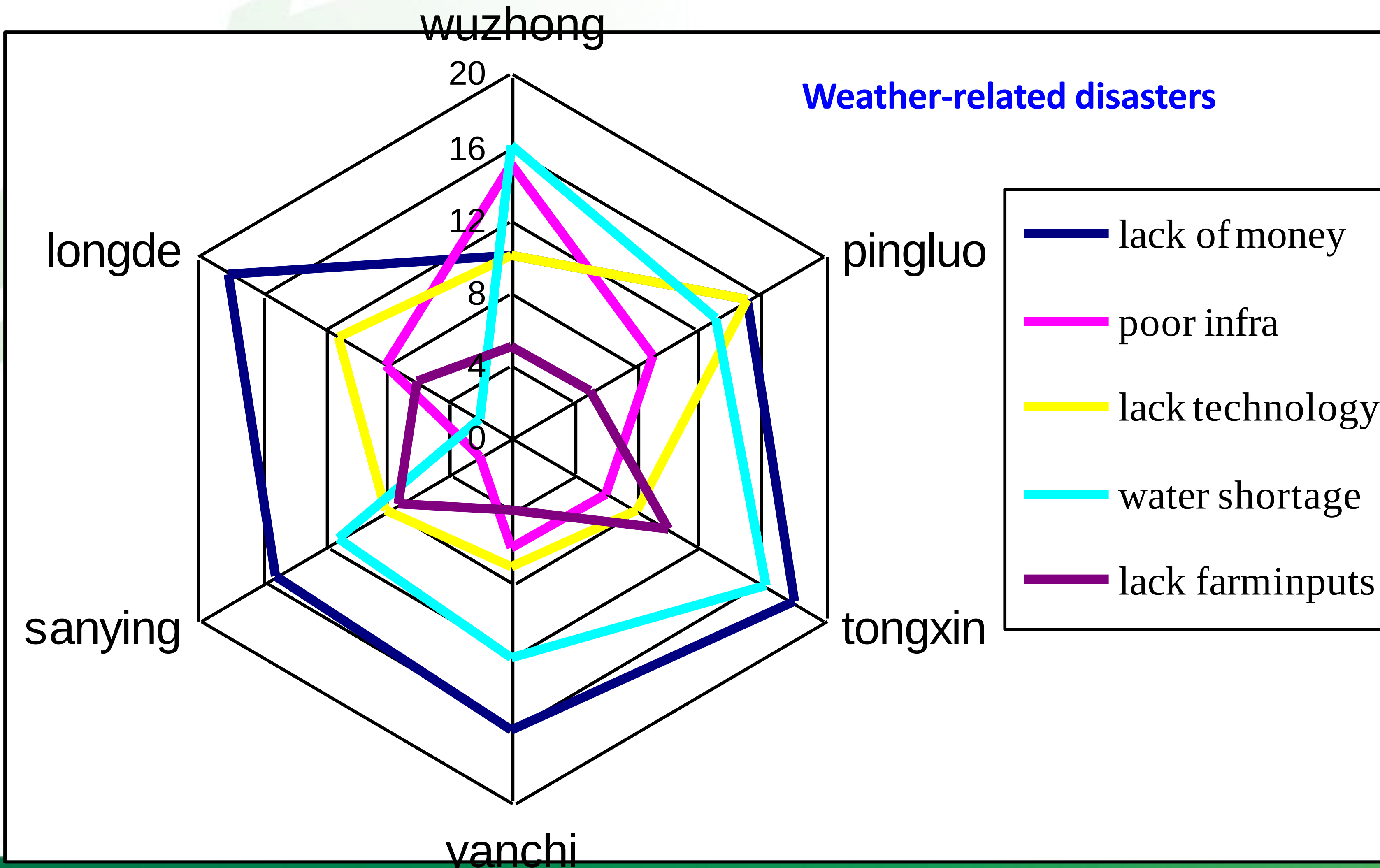
How are communities adapting to drought?

- Diversification – non-farm activities
- Specialisation – e.g. water melons, wolfberry production, livestock breeding
- Change crop types – for water saving
- Rainwater harvesting – water cellar
- Range of soil moisture conservation methods

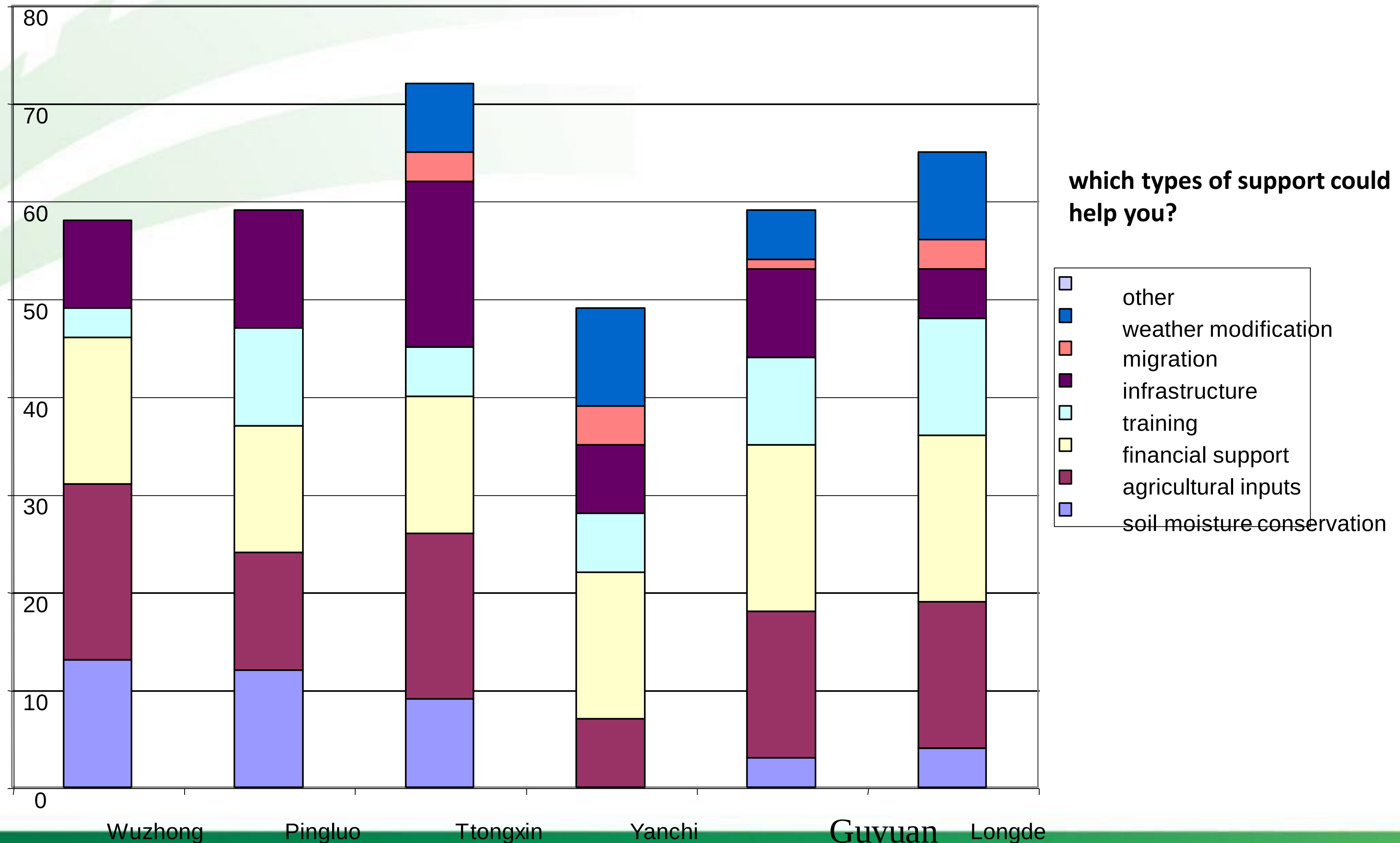
How are farmers adapting to changes in soil moisture?



What are the perceived barriers to responses to climate extremes?



How do communities perceive the need for policy support?



Which factors influence capacity to adapt in rural communities?

Key factors:

- location (especially agricultural zone)
- economic development
- transportation
- education
- gender
- poverty
- age

Conclusion

- Climate factors perceived to have very significant impact on agri production & access to water (drought,sandstorms and frost events)
- Proximity to urban areas and access to irrigation water are important determinants of wealth and non-farming opportunities for local people
- Credit, infrastructure and technology are perceived as the primary barriers to adaptation.
- The most important factors influencing agricultural income during the past ten years are disasters, fertilizer price and cereal price
- Survey areas with mixed irrigated and rainfed farming appear particularly sensitive to climate variability.

Discussion

- **How to reduce greenhouse gas emissions in agriculture**
- **How to strengthen the capacity adapt to climate change**
- **How to use S&T to response to climate change**
- **How to enhancing Public Awareness and Improving Management**

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Thanks for listening

Questions, comments and suggestions are welcome

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