WORLD METEOROLOGICAL ORGANIZATION

Global Water Partnership

Integrated Drought Management Programme (IDMP) Case Study

Benefits of action and costs of inaction in a water reservoir project for agricultural purposes in Azacualpa, Honduras

José Manuel González

Contents

About this case stuy

This study was developed by GWP Central America in coordination with the IDMP, following the severe drought that affected the region in 2014 and caused the loss of crops (maize and beans) to an estimated 168,278 small producers in Honduras.

Correct citation:
Global Water Partnership Central America (2017). Benefits of action and costs of inaction in a water reservoir project for agricultural purposes in Azacualpa, Honduras (José Manuel González). Integrated Drought Management Programme (IDMP) Case Study. GWP Central America, Tegucigalpa, Honduras.

Abstract

Drought in the central American region is characterised by a variation in rainfall distribution, manifested by a few rainy events among long periods without rainfall within the rainy season, among other aspects (GWP 2014). This situation severely affects production cycles of agricultural producers, who heavily rely on rain-fed agriculture and lack adequate technology to face droughts; negatively influencing overall economic and social stability, and wellbeing.

This study analyses the cost of inaction and the benefits of action in Azacualpa, a small village in the outskirts of Tegucigalpa, the capital City of Honduras, where 27 reservoirs were built as a strategy to face drought, which had been affecting up to 70% of horticultural production; by an alliance involving financial, technical and organizational support from the public sector, the international cooperation and the community itself; to support Azacualpa's small scale horticultural producers.

In order to account for the cost and the social and economic benefits of action, and the cost of inaction; the analysis compares scenarios before and after the construction of reservoirs, comparing costs and benefits in each scenario, through an analysis of the current value of action and an estimation of its value in ten years' time (the cost of the reservoirs was apportioned among ten years), including the flow of damages suffered during the ten years of inaction, plus the current value of the cost of adaptation in ten years, and the costs of residual damages from then on. The first scenario (inaction) runs a cost benefit analysis considering the costs of inputs for horticultural production before the reservoirs were built, whereas the second scenario (action) runs the analysis considering the costs of the reservoirs plus horticultural inputs. Both scenarios also consider income through sales of products and other social benefits as less migrations, employment generation, etc. Afterwards, both cost-benefit indexes are compared.

The calculations for this case study were based on historical productivity data, and were validated through a survey to compare the social

and economic status of the population under study, establishing average values for the last five years; which in turn, allowed a comparison projected to ten years, to analyze action vs. inaction.

If no action was taken, meaning, if the reservoirs had not been built, other type of agricultural productive investments would have not taken place. Deeper losses and a greater migration of the population would have occurred.

The main benefits found for the population under study, through the implementation of the reservoirs, were significant improvements in employment (from 30% to 70%), better organizational capacity, more productivity, social cohesion and well-being, income levels (rising from US$ 1.60 to $3.84 per day), economic turn overs (36% return on investment), diversification of crops (from 10 to 15), increasing the yearly production cycles (a range from 1 to 4), food security (26% maize and 23% beans production increase), better market access, increased access to financial services, increased land value (by 47%), and a decrease in migration patterns. On the other hand, the cost of inaction would have income levels losses related to production of US$ -99,783.21 for the population under study, and the annual loss would have been greater than 50% of the investment in production inputs.

The calculated cost benefit estimate for this case study yielded a value of 0.21, which before the reservoirs, was 30.6, indicating an increase in social well-being that goes beyond economic aspects (the closer the value to zero, the greater the benefits).

Therefore, access to water for year-round production has been a determining factor for social and economic change to face droughts; coupled with community contributions, organisation, participation, and leadership; plus, a responsive public sector.

1. Problem statement

Azacualpa is a community located in the outskirts of Tegucigalpa, the capital city of Honduras, with a population of 1600 approximately. Their main economic activity is horticulture production to be sold in Tegucigalpa; and to a lesser extent, basic grains for their own consumption. Some of the producers belong to the small horticultural community enterprise 'Vegetables producers from Izopo and Azacualpa- PROVIASA', created with support of the Rural Enterprise Development Foundation (FUNDER) in 2007.

Azacualpa has a favourable micro-climate for horticultural production, despite being located in the Dry Corridor. The dry season runs from December to April (246 days without rain (MIAMBIENTE et al 2014), and the rainy season runs from May to November, showing increasing variability in rainfall patterns. (FEWS 2005).

During the last years, surface water flows have decreased, affecting up to 70% of productivity to meet market demands of 12 farming communities[1], aggravated by lack of adequate technology and efficient irrigation systems. This may be explained through the climate change scenario that the region faces, affecting many small producers which activities are vital for food security in Centroamérica (CEPAL 2001). The threat becomes more serious considering the high risk of desertification, which involves land degradation in arid, semi-arid and sub-humid environments, because of factors associated with climate variation and human activity (GWP 2014). Community leaders have implemented local solutions, such as bringing water a few kilometres away through pipes, and reducing production to a single four-month production cycle[2] per year, and also reducing diversity of crops. The major production cycle runs from May to November; given that only 39% of producers addressed for this study had sprinkler irrigation systems.

In the Honduran agricultural sector, drought mainly manifests itself through crop loss, reduced crop acreage and water supply problems in terms of both quantity and quality. The effects generated have significant impact on the Gross Domestic Product (GDP), which is why this issue is very high up in the political agenda (Ramírez, 2007, Echeverría, 2009 cited by GWP 2014).

[1] Azacualpa communities: Las Trojas, El Aguacate, La Puerta, Santa Elena, Las Trancas, El Carrizal, Santule, El Sabacuante, El Rincón, El Lagar, Las Flores and Los Planes.

[2] Vegetable production cycles: some crops/products have 30- to 45-day cycles (such as cilantro, radish, bean, squash, sweet corn, baby corn) whereas other types of high-consumption vegetables (potato, tomato, onion, peppers, carrot, cabbage, beet) have 4-month cycles

The 2014 drought has severely hit 10 departments and 64 municipalities across southern Honduras, affecting 76,712 small producer families, causing bean prices to skyrocket, sometimes even by 132% (GWP 2016).

Migration could be a direct effect of the lack of economic stability, given that 39% of the survey respondents claim to have relatives who have migrated either abroad or to Honduran cities.

2. Decisions and action taken

At national level, the Presidential Commission for Coordination of the Water Sector in Honduras (CON-AGUAH) was created in 2015, to promote activities for drought-stricken communities, coordinated by the Minister of Agriculture and Livestock (SAG) (UNDP 2010). Also, the Governmental Drought Action Plan for Food Security, provides food assistance to 161,403 families in municipalities affected by severe and moderate drought.

Within this framework, the Irrigation and Drainage Directorate of SAG, through its National Water Harvesting Project, developed a strategy to build 27 reservoirs to address the problem. The reservoirs range from 3,100 to 67,000 m^3 in volume, and from 2.75 to 8 metres in depth, with the potential to provide year-round irrigation to 128 hectares. The project included capacity building and support for technical and organisational aspects for operation, maintenance and sustainability; including an irrigation system maintenance program, as well as the start-up of the Irrigation Districts (15-20 members each).

The Irrigation Districts establish a need-based irrigation schedule to ensure all users have equal access to water; and have a legal structure recognized by national authorities to exploit the reservoirs. Reservoirs were built following technical design criteria that would ensure the best possible outcome from the intervention. Only 11% of reservoirs had to be waterproofed due to the type of soil. All other reservoirs are fully functional. The project prompted a local private initiative to build eight additional reservoirs, expanding the area under irrigation to a total of 183 hectares.

3. Methodology for the study

In order to conduct a cost-benefit analysis, scale values were assigned to measure intangible variables, with similar ranges to allow comparison.

A limit to the study was the lack of production, sale prices and production costs data records, relying only on information provided voluntarily by farmers and on reservoirs investment costs provided by SAG. It´s important to consider that to establish relationships and comparisons to other places in the country.is necessary to take into consideration the site's biophysical and socio-economic conditions as well as its microclimate.

The study uses the current value of action and estimates its value in ten years' time (the cost of the reservoirs was apportioned among ten years, and includes the flow of damages suffered during the ten years of inaction, plus the current value of the cost of adaptation in ten years, and the costs of residual damages from then on.

Residual damages are considered as all effects related to climate change that can reduce inhabitants' incomes, increase poverty rates and generate social conflicts. Therefore, the value of action depends on three factors: the social discount rate, the perception of risk and uncertainty, and the unique response to extreme natural phenomena. (ACDSCC 2016).

In order to account for the cost and the social and economic benefits of action, and the cost of inaction; the analysis compares scenarios before and after the construction of reservoirs, comparing costs and benefits in each scenario. The first scenario (inaction) runs a cost benefit analysis considering the costs of inputs for horticultural production before the reservoirs were built, whereas the second scenario (action) runs the analysis considering the costs of the reservoirs plus horticultural inputs.

Both scenarios also consider income through sales of products and other social benefits as less migrations, employment generation, etc. Afterwards, both cost-benefit indexes are compared.

The study considers intangible values at the house hold (labour, income distribution, vulnerability to migration, family integration) and at the community (community engagement, community improvement); impacts on livelihoods (natural, physical, human, financial and social capital); and actions undertaken by producers in adverse conditions; in order to identify any imbalances that may have been caused.

The cost-benefit estimate was calculated based on this equation: $fU=C/(X*y)$,where the result indicates the magnitude of benefits generated among the population; C is the cost of the reservoirs; and $(X*y)$ is the product of intangible values. The greater the magnitude of benefits, the closer the resulting value will be to 0.

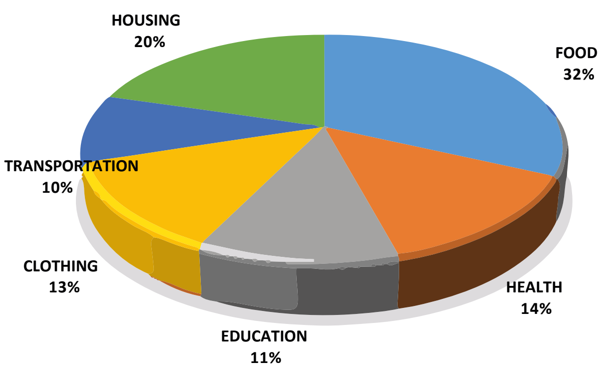
Information was gathered through surveys, targeting inhabitants aged 19 onwards. 28% of the respondents were women heads of households, and only 34% claimed to have access to water for domestic use.

4. Outcomes

The reservoirs allowed staggered planting, strengthening of the horticultural value chain, increasing sales and production cycles, employment, income generation, and the local distribution of economic benefits, transitioning to commercial production. Per capita income rose from US$ 1.60 per day to US$ 3.84 per day (41.5%), moving beyond the poverty line in the international poverty rate indicator (World Bank, 2013).

The target population perceived that before the reservoirs, they were earning only 35% of the income necessary to meet their basic needs (education, food, health, housing, transportation and clothing (Ferullo 2006))[3]. Afterwards, this perception rose to 65%. Figure 1 shows how income is distributed among basic needs.

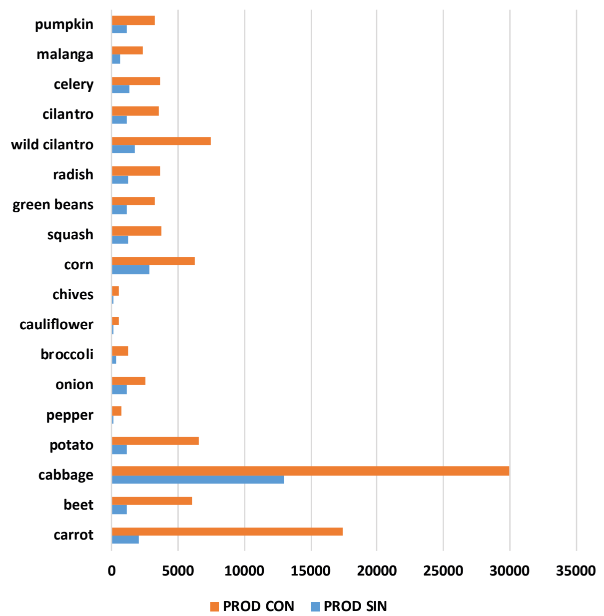
Figure 1. Distribution of family income per type of basic needs expenditure



The population also perceives lower vulnerability to migration: through inaction, the population under survey claimed that they perceived that a73% of the population would have been vulnerable to migration, whereas through the action, this perception drops to 29%. Those surveyed claim they no longer need to leave the community to have enough to live on.

They have also increased the diversification of the type of crops grown from 10 to 15, and the number of cycles from 2 to 4, for those with irrigation, and from 1 to 4 for those who had no irrigation prior to action, increasing the capacity to meet market demands. Figure 2 shows the diversification of crops.

Figure 2. Comparison of production with inaction versus action



[3] Amartya Sen, 2000. Primary needs related to food and health, as well as more complex functions which social life requires, such as personal dignity and full integration (without inhibition) into any community affairs the subject deems valuable.

The irrigation districts have joined other community organizations, increasing the sense of community belonging, well-being and usefulness generated through the reservoirs, also contributing to labour and family stability, and to social cohesion; by encouraging and reinforcing the population's roots to the site. In addition, the project has enabled greater participation by women in family productive activities.

5. Analysis of the cost of inaction and the benefits of action

The study found that basic grain production increased by 26% for maize and 23% for beans, due to year-round irrigation.

The cost-benefit analysis (Sabalza 2006) at the household level found a rise in employment rates from 30% to 70%, since the period of time requiring labour rose from 37% to 63%. Community participation levels rose from 38% to 62%, because of the perception of having greater chances of effective achievement of solutions through association in face of a collective problem.

Community improvement (education, health, trade, employment, financing and land value) perceptions rose from 37% to 63%. The price of land with access to water for irrigation increased by 47%, while the cost for leasing these types of plots rose by 38%, increasing land capital gain and improving access to financial services at favourable interest rates.

To perform the cost-benefit analysis, values for the reservoir, the production, the cost of production, income through sales of products were compared before and after the project.

The calculated cost benefit estimate for this case study yielded a value of 0.21, which before the reservoirs, was 30.6, indicating an increase in social well-being that goes beyond economic aspects (the closer the value to zero, the greater the benefits).

The current internal rate of return, based on 8% bank annual interest rates, was 18%, showcasing viability of the project, with a financial profitability that is almost double the cost of opportunity to a bank savings account; a current positive net value of US $ 199,627.80; and a cost benefit of 1.36; i.e. there is a US$ 0.36 return for every dollar invested.

Before the reservoirs, producers had been accumulating an annual economic loss of 5%, having a current negative net value of US $ -99783.21,. This estimate looks not only at the reservoirs, but also to its productive capacity and the income generated through increasing yields during the year (ranging from one yield per year to four) and the sales of agricultural outputs. According to this estimate, producers used to fail to even cover investment costs, showing a growing cumulative annual loss greater than 50% of the investment, without even taking into account the loss of market share, which they consider irreparable because competitors would move in and take it over. This loss (5 % per year) could be influenced by drought conditions and the lack of a water sources for irrigation.

The initial investment of US$ 450,000 to build the 27 reservoirs, compared to a previous strategy of providing food vouchers during the ten years under analysis, would have cost approximately US$ 1,721,739.13, four times as much as building the reservoirs; and would have not contributed to sustainability and deepening dependence on emergency relief

6. Replicability, recommendations and lessons learned

Replicating and enriching the experience would require taking the following aspects into account:

- Increasing staggered production for crops, for strengthening the cash flow, and would favour the sustainable use of land by rotation of crops.
- The type and composition of soil, infiltration capacity, rainfall and evaporation patterns, etc., need to be assessed by experts, including running physical quality tests, to ensure proper design, budgeting and future reservoir functioning.

- Efforts must be coupled with strengthening farmers' skills aimed at improving agricultural practices and efficient use of water according to different types of crops, to meet actual demand based on reservoirs volumes, supporting transition from subsistence to commercial agriculture.

- A participatory approach that includes existing community based organizations in every stage of the project is necessary, in order to avoid conducting activities that, although necessary, may not be deemed important by the population, as this may negatively affect sustainability, and to ensure producers support compliance thereof.

- Land owners must be willing to legally cede the land for reservoirs via agreements subscribed among parties before any construction work is undertaken.

- A financing mechanism supporting producers with a 10-year term must be considered, to avoid affecting the economic flow.

- It is important to frame every action within national policy, for decision making effectiveness, and to have timely communication systems that provide information from the field to public offices. Also, reservoirs could be part of a long-term strategic public policy in support of organised response to droughts, as opposed to a reactive approach; which increases costs.

- It is necessary to analyse the need to recover the region's water producing areas, as well as riparian forests, in order to restore the biophysical conditions and water regulation capacity, which will increase water availability during the dry season.

- Achievements are largely due to the holistic approach and comprehensive response undertaken by institutions (national authorities, NGOs, market actors and financial system), and the willingness of the population involved to become organized into irrigation districts, which proved to be a key factors.

- Local response options to face drought should be encouraged before other options as migration or the implementation paternalistic approaches that are unsustainable in the long term.

- Involving the private sector for market development should be considered in order to achieve comprehensive response and provide sustainability to outcomes stemming from adaptation actions

7. Concluisons

- Social organization, including leadership, effective participation and coordination among stakeholders, can be a strategy for climate change adaptation, as evidenced through the establishment of irrigation districts, supporting water governance and efficient use of water, and at a longer term, improving resilience.

- Overall, the project showcased how response from decision-makers coupled with contributions from the target population can influence the quality of life of a community.

- There is substantial improvement in the employment rate, going from 30% to 70%, and an important decrease in the perception of vulnerability to migration, which dropped from 73% to 29%.

- The socio-economic analysis shows a significant gap among action and inaction. Without reservoirs, income and production levels losses would have been US$ -99,783.21 On the opposite, a viable positive net value of US$ 199,627.80, and a 36% return on investment was achieved, far exceeding the cost of inaction. Income levels rose from US$ 1.60 to $3.84 per person per day, supporting positive economic flows. Additionally, the perception of the community of having the necessary income level to meet their basic needs rose from 35% to 65%.

- Food security was also improved, through an increase in crops for self-consumption as maize and beans, which registered and increase of 26% and 23%, respectively.

- The cost-benefit analysis showed a lower distribution of benefits through inaction, yielding a value of 30.6 versus the 0.21 value resulting from successfully operational reservoirs, increasing social well-being.
- As a consequence of the reservoirs, land price value increased by 47%, and 38% for leasing; improving access to financial services.
- The study provides evidence that reservoirs built with proper biophysical conditions and technical designs, become a good measure for climate change adaptation in conditions of droughts; coupled in this case, by the diversification of crops achieved through an improved access to water for irrigation.
- Before the reservoirs, only one or two crops per year were produced. Afterwards, and through a staggered production system coupled with sprinkler irrigation, production cycles increased to 4 per year. Also, arable land area rose from 50 to 183 hectares. Therefore, access to water for year-round production has been a determining factor for social and economic change.

8. Bibliography

ACDSCC. Revisado el 21 de julio2016.Contexto Económico de la Adaptación al Cambio Climático, Departamento de Economía de las Instituciones, Estadística y Econometría de la Universidad de La Laguna, Canarias España. 38p. https://npadron.webs.ull.es/Docuweb/estudio_previo_economia-GOBCAN.pdf

World Bank. 2013. Índice de Desarrollo Mundial Disponible en http://wdi.worldbank.org/table/2.8

CEPAL 2001. El impacto socioeconómico y ambiental de la sequía de 2001 en Centroamérica. Autor(es) Institucional(es): Comisión Centroamericana de Ambiente y Desarrollo | NU.

CEPAL. Subsede de México.Fecha de publicación:2002-08-20.65 Ferullo, H. 2006. El concepto de Pobreza en Amartya Sen. Disponible en https://dialnet.unirioja.es/descarga/articulo/2149671.pdf

IFAD 2010. Evaluación Ambiental y del Cambio Climático. Para la preparación del Programa sobre Oportunidades Estratégicas Nacionales 2012-2016 del FIDA. Tegucigalpa. 52p.

GWP. 2014. Patrones de sequía en Centroamérica Su impacto en la producción de Maíz y frijol y uso del Índice Normalizado de Precipitación para los Sistemas de Alerta Temprana. Tegucigalpa, M.D.C, Honduras. 2014. 52P.

GWP 2016. Socio-economic Analysis of the Sectoral Impacts of the 2014 Drought in Central America.GWP Centroamérica

MIAMBIENTE.; Fondo de Adaptación, PNUD, IHCIT-UNAH, SANAA, COPECO, IMN, ICF, AMDC, ICF, SEPLAN,2014. Evaluación de los recursos hídricos en su régimen natural a nivel nacional, Proyecto Fondo de Adaptación. Tegucigalpa. Honduras. 37p.

MFEWS. 2005. Perfiles de Medios de Vida Honduras septiembre 2005. USAID. Tegucigalpa. 144p.

UNDP, 2010. Promoviendo el Manejo Integrado de Ecosistemas y de Recursos Naturales en Honduras. Tegucigalpa. 194p.

Sabalza, M. 2006. Evaluación económica de proyectos de cooperación, Hegoa, diciembre, Bilbao. España. 46.

Glossary of terms

ACDSCC	Canary Islands Agency for Development and Climate Change
CON - AGUAH	Presidential Coordination Commission for the Honduran Water Sector
FUNDER	Rural Enterprise Development Foundation
GWP	Global Water Partnership
IFAD	International Fund for Agricultural Development
FEWS	Famine Early Warning Systems Network
PROVIASA	Izopo and Azacualpa Vegetable Producers
SAG	Honduran Agriculture and Livestock Secretariat

The **World Meteorological Organization (WMO)** is a specialized agency of the United Nations. It is the United Nations system's authoritative voice on the state and behaviour of the Earth's atmosphere, its interaction with the land and oceans, the weather and climate it produces and the resulting distribution of water resources. WMO has a membership of 191 Member States and Territories.

www.wmo.int

The **Global Water Partnership (GWP)** is an international network whose vision is for a water-secure world. The GWP mission is to advance governance and management of water resources for sustainable and equitable development. The GWP network is open to all organizations that recognize the principles of integrated water resources management endorsed by the network.

www.gwp.org

The **Integrated Drought Management Programme (IDMP)** was launched by WMO and GWP at the High-Level Meeting on National Drought Policies in March 2013. IDMP works with a wide range of partners with the objective of supporting stakeholders at all levels. IDMP provides its partners with policy and management guidance through globally coordinated generation of scientific information and sharing best practices and knowledge for integrated drought management. It contributes to the Global Framework for Climate Services (GFCS), especially regarding the GFCS priority areas of disaster risk reduction, water, agriculture and food security, energy and health. It especially seeks to support regions and countries in developing more proactive drought policies and better predictive mechanisms. This working paper contributes to that objective.

www.droughtmanagement.info

For more information, please contact:

Integrated Drought Management Programme Technical Support Unit
World Meteorological Organization and Global Water Partnership
7 bis, avenue de la Paix – P.O. Box 2300 – CH 1211 Geneva 2 – Switzerland
Tel: +41 (0) 22 730 83 05, Fax: +41 (0) 22 730 80 42
Email: idmp@wmo.int

GWP Central America
Apartado Postal 4252, Tegucigalpa, Honduras
Tel: +504 2232 0052
Email: gwpcam@gwpcentroamerica.org
Web: www.gwpcentroamerica.org