Utrecht University – Faculty of Geosciences

The implementation of ecological restoration in Spain: challenges and opportunities

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Abstract

This study examines policies containing the method of ecological restoration in Spain. Large areas of Spain are affected by drought issues, causing adverse effects on economic activities, health, and social and psychological well-being. Practices of ecological restoration could solve the underlying causes of drought, such as land degradation, erosion and a lack of vegetation. Although this method is incorporated in several national and regional policies, the effectiveness of addressing drought issues by the method of ecological restoration is limited. A comprehensive analysis of the reasons for this limited effectiveness does not yet exist. Therefore, this study aims to identify the challenges and opportunities for decision makers at the national and regional level for the successful implementation of ecological restoration. In order to identify the challenges and opportunities, relevant national and regional policies containing plans for ecological restoration will be analyzed in terms of case-study-criteria at the level of organizing, governing, planning, implementing and accounting. It will become clear that challenges exist at all levels. More specifically, the main challenges include the lack of a well-developed plan with well-elaborated measures, lack of involvement of stakeholders, scientists, experts and technical people, and insufficient funds. This is valuable knowledge for policy makers both at the national and regional level, to improve the effectiveness of policies containing ecological restoration in the near future.

Key words: climate change; drought; ecological restoration; policy analysis; Murcia, Spain

Content

Abbreviations

AEM	Agri-environmental Measures
DLDD	Desertification, land degradation and drought
EC	European Commission
EU	European Union
HRP	Hydrological Restoration Plans
RDF	Rural Development Plans
RAEM	Regional Agri-environmental Measures
NAP	National Action Plan to combat desertification
PNAP	National Plan of Priority Actions for Hydrological Forest Recovery and Erosion Control
SAEM	Spanish National Agri-environmental Measures
SNFP	Spanish National Forest Program
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
ZNLD	Zero Net Land Degradation

1. Introduction

Not only water but also a fertile soil is the starting point of life. A fertile soil is necessary for efficient food production and security and to meet the needs of the ever growing world population and consumption. However, the importance of a fertile soil is generally overlooked and overexploitation is a common result of large-scale agricultural practices (UNCCD, d., 2012). Due to mismanagement and overexploitation, large areas of land are degraded. Land degradation is widespread and covers approximately 23% of the globe's terrestrial area and affects 1.5 billion people globally (Stavi & Lal, 2005). Inhabitants of climatically marginal areas of the world face the worst consequences of land degradation, including starvation, death, and migration. In the developed world, these consequences inlude adverse effects on economic activities, health, and social and psychological well-being (Conacher, 2009).

Land degradation includes the decrease in soil fertility and a decrease of natural vegetation which in turn will lead to a poor soil structure with low infiltration-rates that results in erosion and eventually will lead to drought (Morgan, 2005). Drought has destructive socio-economic and environmental consequences, such as food insecurity, conflict (e.g., water wars) and negative impacts on climate change (Estrela & Vargas, 2012). A Solution in order to secure the availability of productive land for present and future generations already exists, as several cases[1] proved (Li & Shao, 2006; Harris et al, 2006). Practices of ecological restoration on degraded lands restore natural capital, make water available in root zones and result in healthy vegetated areas (UNCCD d, 2012). This method combats desertification, land degradation and drought (DLDD) and is perceived as the most efficient and cost-effective solution (Aronson et al., 2007).

Restoration of ecosystems became a target for the UN Convention to Combat Desertification (UNCCD) and is part of the Zero Net Land Degradation-plan (ZNLD) (Estrela & Vargas, 2012). Decision makers at the national and regional level are responsible to implement these restoring-practices in all drought-prone regions by 2020 to achieve ZNLD by 2030 (UNCCD d, 2012). More about the structure and design can be found in Appendix I. The achievement of ZNLD and the accomplishment of economic productive land by ecological restoration is possible (Nkonya & Anderson, 2015). But in order to do so, a collective effort to place large-scale ecosystem restoration at top of the national priorities is needed (Vigmostad et al., 2005). Despite increasing attention for drought issues both in the UN and affected countries, intended restoration practices are not yet successfully incorporated in the national policies of the UN member states, as we can learn from the case of Spain (Estrela & Vargas, 2012).

Within Europe, Spain is one of the countries most affected by drought (as can be seen in Appendix II). Additionally, Spain is highly vulnerable to the effects of drought because it is a semi-arid area (Carcía-Ruiz et al., 2013). Semi-arid areas are especially vulnerable to land degradation because of their soil's coarse texture, low organic matter content, low water and nutrient retention capacities, low inherent fertility and low resilience (UNCCD d, 2012; Mueller et al., 2014). There is high confidence that water scarcity and droughts will worsen by climate change effects in Spain, as the combination of land degradation and climate change drive each other in a cyclical downward spiral (as can be seen in Appendix III) (UNCCD, 2014). Problems of drought got attention of the Government of Spain and led to the establishment of far-reaching drought policies such as the Hydrologic Plan Act and Drought Management Plans (UC riverside, 2010). However, with the establishment of these plans, the government of Spain prioritizes water efficiency and technological innovations which do not deal with the underlying structural causes of drought, such as land degradation and the lack of vegetation. Practices of ecological restoration could tackle these problems in an effective way, but only play a limited role in the policies of Spain. Meanwhile, effects of drought are becoming increasingly visible in Spain, as the highly

1 China's Loess Plateau, the Egyptian desert near Cairo, the Molai forest in India, the Everglades in South Florida, and the Gishwati forest in Rwanda.

inefficient and barely profitable agricultural practices resulted in a leaving population and abandoned land (Imeson et al., 1998).

The Guadalentín Basin in South-East Spain is such an abandoned region suffering from intense land degradation. A combination of erosive farming practices, a huge increment of irrigated intensive agriculture, semi-arid climatic conditions and a vulnerable soil resulted in low-productive land and a leaving population. Abandoned land has negative effects[2] causing further land degradation (Imeson et al., 1998). The lack of vegetation leaves the soil unprotected and has destructive effects. Therefore, an optimal incentive for farmers to adopt effective soil conservation practices by ecological restoration is necessary, but still limited because of the high investment costs.

It is clear that large-scale ecosystem restoration needs to be a top priority of the national and regional policies in order to solve the problem of drought. However, there are no explicit ecological restoration policies in Spain that solely focus on ecological restoration, but ecosystem restoration practices are intertwined in other drought- or agricultural policies[3] (Martínez Fernández, 2003; Wilson & Juntti, 2005). Nevertheless, none of these policy measures adequately addressed soil problems by the successful implementation of ecological restoration (Calatrava et al., 2011). Both opportunities and challenges for the successful implementation of ecological restoration exist at the national and regional level, but are not precisely analyzed yet. However, these challenges and opportunities need to be identified for further policy developments.

In this study, the current state of implementation of policies containing ecological restoration will be analyzed in terms of case-study criteria[4] and will produce more insights about the challenges and opportunities of implementing ecological restoration at the national and regional level in Spain. This knowledge will be valuable for policy makers at the national and regional level to solve the problem of drought on degraded lands effectively in the future.

Therefore, the main research question is as following:

What are the challenges and opportunities for decision makers at the national and regional level to implement ecological restoration successfully in Spain?

First, the framework used in this research will be described and the scope of this research will be justified. Additionally, concepts of drought, ecological restoration, and successful will be clarified. Second, methods to obtain and analyze data are indicated and specified according to each chapter. Third, national policies containing ecosystem restoration will be analyzed. Fourth, regional policies containing ecosystem restoration regarding the Guadalentín Basin will be analyzed. Eventually, the challenges and opportunities of implementing ecological restoration in Spain will be identified and policy recommendations will be provided.

[2] First, the erosion of poorly maintained agricultural terraces will release sediments into the environment. Second, lower amounts of sediment reaching the river channel can lead to increased channel erosion. Third, a dramatic reduction in water-table levels and in low flow discharges (Imeson, 1998).

[3] Spanish National Action Plan to Combat Desertification, Spanish Reforestation Plan, National Plan of Priority Actions for Hydrological Forest Recovery and Erosion Control, Spanish National Agri-environmental Program, Local Agri-environmental Program, and Hydrological Restoration Plans.

[4] Regarding organizing, governing, planning, implementing and accounting.

2. Theoretical framework

2.1. Actors

Within Europe, consequences of drought have the largest socio-economic and environmental impacts in the Mediterranean area, especially in Spain and specifically in the Murcia region. The UN decentralized the responsibilities of implementing ZNLD to national authorities. For this reason, this research focuses on the national and regional authorities of Spain only, and leaves the European Union (EU) and the UN disregarded. The main characteristics and policies concerning drought issues of Spain and the Murcia region will be elaborated below.

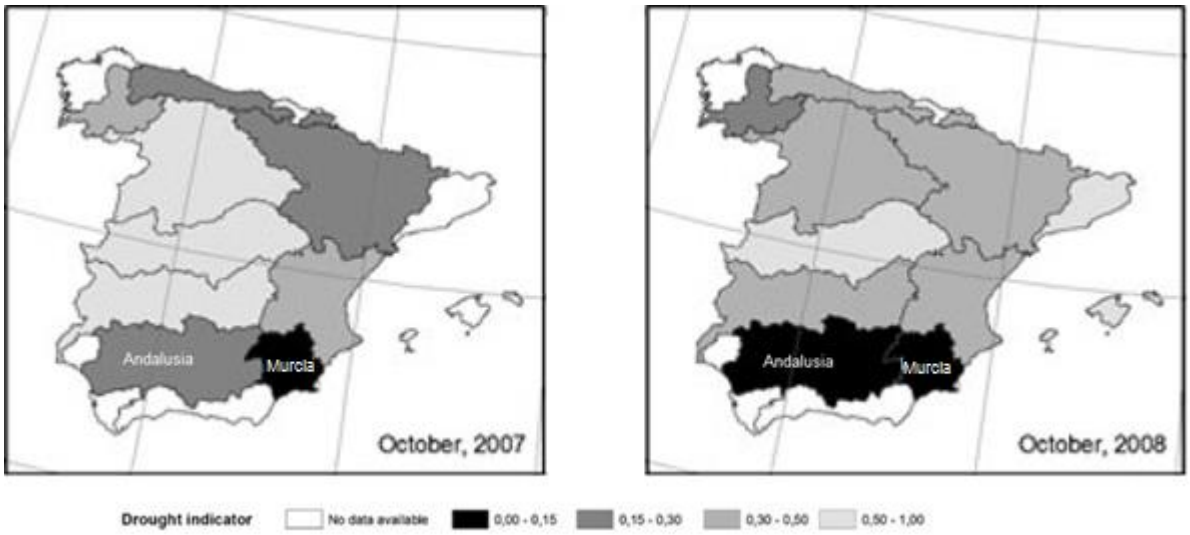
2.1.1. Spain

Although national mean values reflect enough available water resources for all users, the irregular temporal and spatial distribution of water resources and a fragile balance between water resources and demands causes water scarcity in specific regions (Estrela & Vargas, 2012). This includes hydrologic drought and agricultural drought, as 68% of water resources is demanded for irrigation (Garrido & Llamas, 2008). The government of Spain established several policies concerning drought issues (Appendix IV). But these are mainly focused on water savings by innovative developments and reducing irrigation practices by providing economic compensation for farmers (Estrela & Vargas, 2012). However, this approach does not deal with structural problems underlying drought (Estrela & Vargas, 2012; Conacher, 2009). This implies a strategy focused on adaptation instead of mitigation.

2.1.2. Murcia region

The Guadualentín basin is located in Andalusia and Murcia and suffers from the most intensive drought, as can be seen in figure 1 (Estrela & Vargas, 2012). Murcia covers 67% of the basin and hosts most of the people and agriculture of the basin, although the rural population is very low. The dominant social economic processes within Murcia include irrigated agriculture, land abandonment, and urbanization. There is no explicit and consistent soil conservation approach, although these issues are the objective of some other policies[5]. The regional government of the Murcia region can adopt some policies, but must respect the basic UN, EU and national framework (Calatrava et al., 2011).

Figure 2. Maps showing the drought status of Spanish river basin district in October 2007 and 2008



Legend status: emergency (0,00–0,15), alert (0,15–0,30), pre-alert (0,30–0,50) and normal (0,50–1,00). Source: Estrela &Vargas (2012)

[5] REAM and HRP.

2.2. Relevant concepts

2.2.1. Drought

Drought is an extended period when a region suffers from a deficiency in its water supply. This deficiency can be divided into four types of drought: hydrological, socioeconomic, meteorological and agricultural. Hydrological droughts focus on water reserves in reservoirs, lakes and aquifers. Hydrological droughts occur when these water reserves drop below an pre-defined level; socioeconomic drought occurs when the need for water exceed the reserves (even if the amount of precipitation is average); agricultural drought occurs when the amount of precipitation is not enough to grow crops and grass for livestock; and meteorological drought is the reduction of water over time due to the lack of precipitation (Wilhite & Glantz, 1985). This research will only focus on hydrological droughts (of groundwater) and agricultural droughts, since these problems can be reduced by ecological restoration.

2.2.2. Ecological restoration

Ecological restoration is part of the restoration of natural capital, and is the most direct and effective remedy to prevent socioeconomic and political effects of drought (Aronson et al., 2007). Ecological restoration is defined as the intention to repair ecosystems that have been degraded, with respect to their health and self-sustainability (Aronson et al., 2007). Restoration efforts would be in the same ecosystem where land degradation has occurred (Gnacadja & Stringer, 2012). Practices of ecological restoration in arid-regions focus on restoration of soils by adding organic matter to the topsoil, planting native plant species and fertilizer trees. In turn, vegetation contribute to a strong soil structure and enhances the capacity to retain precipitation, which prevents erosion (Morgan, 2005).

2.2.3. Successful

Vigmostad et al (2005) studied and evaluated eight cases of ecological restoration practices[6]. According to the evaluation of these case studies, the presence of factors of the following five levels determines the extent to which the implementation of ecological restoration can be described as successful (Vigmostad et al., 2005). Successful implementation of ecological restoration will effectively combat DLDD. These levels and appropriate criteria are as following:

- Organizing: the achievement of consensus and commitment.

This includes convinced participants, political support, identified stakeholders, the involvement of scientists and technical people, the enlistment of champions, the use of events as opportunities, the obtainment of seed money, and building on successful pilots.

- Governing: the development and implementation of policies.

This includes the adoption of agreements, the establishment of commissions, identified federal and state roles, the acceptation of the inevitability of conflicts, the use of facilitators, and the adoption of conduct codes.

- Planning: a comprehensive, science-based plan with price tags.

This includes defined ecosystem concerns, necessary science, indicators to monitor, determined goals, consensus throughout the system, the selection of actions and measurable outcomes, considered effects of self-repair, accurately calculated costs, allocated responsibilities, established criteria to prioritize actions, a user-friendly-plan, and organizational commitments.

- Implementing: securing of adequate funds and the carrying out of planned restoration actions.

This includes a mix of financial support, necessary scientific expertise and technology, strengthened monitoring programs, models, and case-by-case strategies.

- Accounting: ensure economic, ecological, and political accountability.

This includes mandatory and voluntary enforcement, evaluated outcomes accounted for external stressors, the publication of interim results based on what the public cares about,

[6] In the Chesapeake Bay, Coastal Louisiana, Columbia River, Great Lakes, San Francisco Bay-Delta, South Florida Everglades and Upper Mississippi River.

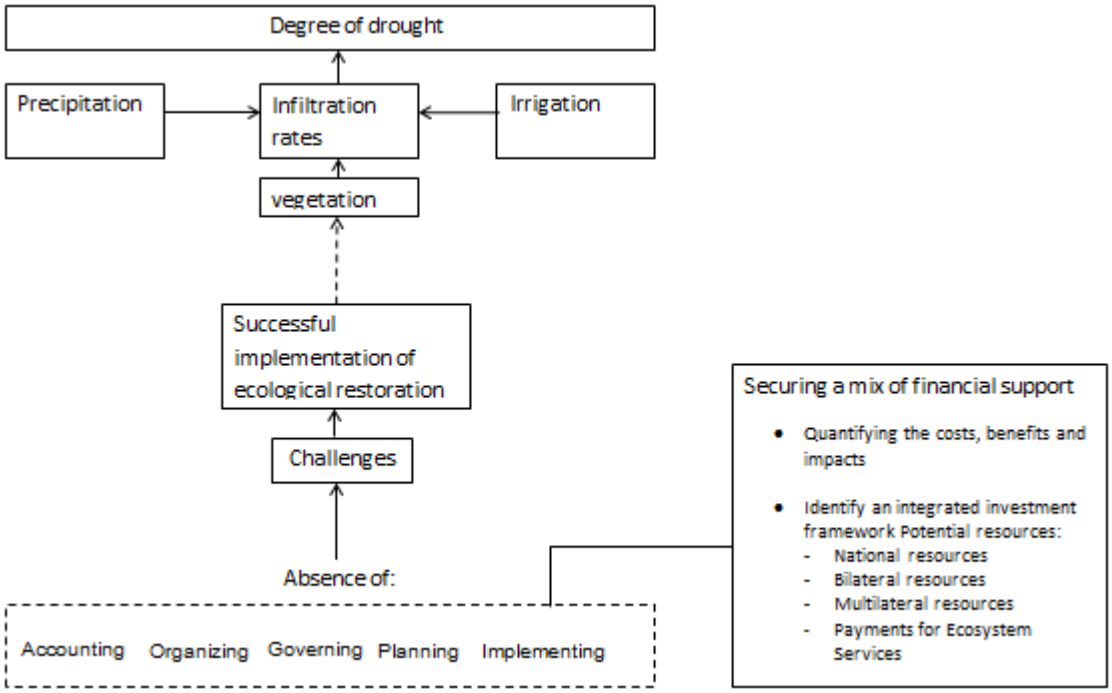
public assessment of progress and success, and the recognizing and rewarding of champions.
Additionally, sufficient funds are a required factor for implementing policies of ecological restoration because of the big investments (UNCCD b, 2013) and therefore need additional attention within this framework. Donors do not provide large amounts of money for projects unless they know what the costs, benefits and impacts are (UNCCD b, 2013). Therefore, a detailed overview of costs, benefits and impacts is needed (Stavi & Lal, 2015). The intended costs consist of direct and indirect costs. Direct costs, of DLDD, include the reduced income through lower productivity and the indirect costs include off-side impacts (UNCCD b, 2013). Benefits include returns on investments in the eco-agro mix zone, the economic zone, and the natural zone (Commonland, 2015; Groot, 2013). And impacts include climate change mitigation (Jenkins & Warren, 2015). Eventually, in search for financial resources, an integrated investment framework should be established in which resources are identified (UNCCD a, 2013). Resources include national, bilateral and multilateral financial resources, and payment for ecosystem services (PES) (Song et al., 2012).

2.3. Conceptual model

The degree of drought depends on several factors, which can be seen in figure 2. The degree of drought is determined by the amount of precipitation and irrigation, mediated by the infiltration rates of the soil. In turn, the infiltration rates are determined by the soil structure, which is determined by the degree of vegetation. Without sufficient vegetation, the infiltration rates are very low and the supply of water (precipitation and/or irrigation) will be washed away by erosion and worsen the degree of drought. In order to enhance the soil structure by adding vegetation, practices of ecological could be the solution, if implemented successfully. The relation between vegetation and the successful implementation of ecological restoration is indicated with a dotted line, as the implementation of ecological restoration influences the degree of vegetation, while the degree of vegetation is not solely dependent on practices of ecological restoration.

In turn, the degree of a successful implementation of ecological restoration is dependent on the existing challenges, which consists of the lack of 5 aspects, namely accounting, organizing, governing, planning and implementing. Special attention is given to the financial aspect of the implementing factor, as is stated above.

Figure 2. Conceptual model



3. Method

3.1. Type of review

First of all, this thesis is a literature study set up accordingly to the engineering-approach, because of the well examined problem and solution. This approach is science-based and part of the analytical-rational view. Therefore, scientific articles will form the base. These will be acquired from Scopus and Google Scholar by searching for concepts from the conceptual model and looking at the reference list for relevant articles. Although the base of this thesis will be formed by scientific articles, also official publications of the UN, Spain and Murcia will be used.

3.2. Use of data

There are many policies concerning drought issues in Spain and Murcia (Appendix IV). However, only policies containing ecological restoration will be elaborated. By analyzing these policies, they will be checked on the presence or absence of aspects mentioned in section 2.2.3. Because of the analytical aspect of this research, no positive or negative judgments will be given.

In section 4, the national policies of Spain containing ecological restoration, will be analyzed. The purpose of these specific policies, including its structure, plans, finances, stakeholder involvement and awareness raising, will be elaborated by using official publications of Spain. Because the national government of Spain decentralizes some policies including ecological restoration[7], the role of Murcia is important as well and their policies will be analyzed in section 5.

In section 5, the policies of Murcia, containing ecological restoration, will be analyzed in the same terms as the national policies. The purpose of these specific policies will be elaborated by using official publications of Murcia and the scientific article of Calatraval et al. (2011).

In section 6, the presence and absence of the criteria will be presented in an overview, following section 4 and 5. Eventually, the challenges and opportunities for the implementation of ecological restoration at the national and regional level will be identified and elaborated.

[7] AEM and PNAP.

4. National policies of Spain

4.1. National Action Plan to Combat Desertification (NAP)

Spain signed the Convention on Desertification in 1996 (UN a, 2012). The Spanish NAP was elaborated by the Ministry of the Environment in collaboration with the Ministry of Agriculture, Fisheries and Food and was approved in 2007. Also the implementation and monitoring was delegated to these ministries (UNCCD, 2006). No new agreements are adopted and no new commissions are established. The actions proposed by the NAP include the integration of measures which are the objective of already existing policies[8]. Linkages between these policies, environmental conventions and national development strategies are identified and well elaborated (UNCCD b, 2013). Its task is to align all policies and create consistency between them.

Determined goals and measurable outcomes are not yet established. Additionally, no specific plans for crops, groups of plants or animals are proposed because of the heterogeneity of the Spanish land (UNCCD, 2006).

In order to make specific locational plans possible in the future, ecological concerns will be identified by monitoring systems (Gobierno de España, 2008). These monitoring plans are well elaborated and several Universities and the Spanish Council for Scientific Research are involved. 40 stations are installed and mapped 13.9% of the national territory, with the aim to map the whole territory of Spain. In addition, Spain leads research initiatives about DLDD and promotes scientific and technical training at the international level (UNCCD, 2006).

Research shows that erosion mainly plays a major role in agricultural land and is one of the major threats to the future of mankind (Oldeman, 1998). In contrast, Stavi & Lal (2015) believe that ZNLD in general focuses too much on agricultural land while ignoring natural lands. Spain seems to found a balance by the incorporation of both reforestation and agri-environmental programs.

No specific budget is available. It is the duty of the NAP to promote the increase of financial support given to the most interesting measures and to foster the allocation of funds to the most affected zones (UNCCD, 2006). Determining the most affected areas is done by the classification of drought, whereby Murcia is classified as ‘arid’, while the other main lands are classified as ‘semi-arid’ (Gobierno de España, 2008).

In order to raise public awareness regarding mitigation the effects of drought, the civil society will be informed and involved (UNCCD, 2006).

4.2. Spanish National Forest Program (SNFP)

The Spanish National Forest Program is incorporated in the NAP to improve the role of forests in soil and water protection, erosion control, watershed regulation, and vegetation-cover rehabilitation (Eritja et al, 2011). The SNFP was approved in 2002 and includes the Spanish Forest Plan (SFP) which has a 30-year timespan (EFI, 2013). The current regulatory framework for the management and conservation of forests in Spain is covered by the establishment of the Forest Law 43/2003 (Molina, 2011; Grebner et al., 2012). This law promotes forest restoration, enhancement, sustainability and rational use, based on collective solidarity and territorial cohesion (Eritja et al., 2011). The Law links different plans[9] that give forest cover a central hydrological and ecological role (Zingari, 2006).

The law applies to all Spanish forests and is applicable to them without prejudice to the provisions of special legislation (FAO, 2013). All lands, including abandoned agricultural land, ascribes to the purpose of being replanted or converted to forest use in accordance with applicable regulations (BOE, 2013). This will add 3,800,000 hectares of vegetable cover,

[8] Strengthening agri-environmental measures program; the afforestation of agricultural land program; reforestation of vegetation cover and increasing the wooded area, sustainable forest management; the fight against forest fires, forest defense and protection; Special Action Plans for danger situations and possible drought; the creation of National Drought Observatory; the integration of groundwater management and protection; and the development of National Irrigation Plans.

[9] Desertification Plan, the National Forest Plan, and the Basin Plans (FAO, 2015).

which increases 20 per cent in CO2 fixation which is 204 million tons in 30 years (Peeters et al., 2012).

The responsibilities are allocated in the context of regional planning. The law acknowledges the multifunctional function of forests in environmental, economic and social values and integrates participation in forest policy of social and economic sectors (BOE, 2013). However, specific responsibilities and tasks are not mentioned. Furthermore, nothing is mentioned about the costs. Funds include subsidies of public administrations, contracts with owners or direct investments in public lands (BERST, 2013). No specific budget is made available yet, but there are proposals to streamline its budget with other European funding proposals (EAFRD, EIP-Agri, CSF funds and LIFE+) (Gobierno de España, 2014) .

Although the plan promotes scientific research, a lack of full scientific certainty is a reason to follow the precautionary approach . Also a monitoring plan is set up to maintain and update the Spanish forestry statistics (BOE, 2013).

4.3. National Plan of Priority Actions for Hydrological Forest Recovery and Erosion Control (PNAP)

The Ministry of the Environment created a general framework for the development of projects for the restoration, preservation and improvement of protective vegetation cover, by the establishment of the PNAP in 2002 (Serrano, 2004). Its objective is to maintain and improve the protective function of forests for soil and water resources to control erosion and improve the water system (Eritja et al., 2011). Reforestation is its main goal and includes the reintroduction of forest species, by sowing or planting, in identified and ranked priority action areas (University of Valladolid, 2013).

Regional governments are able to participate in decision making and thirteen of them signed the national agreements to implement the planned activities and also the River Basin Authorities signed. Also professional forest and agricultural organizations will participate. Alignment between agricultural and forest administrations is supported by Decree 44/1989 (Romero Díaz et al., 2014).

The Ministry of Environment is the main funder and invested more than € 82.5 million to fight against the effects of desertification in Spain (Appendix V). Furthermore, the planned actions are supported by EU funds (Serrano, 2004).

A program for research and monitoring of abandoned land is proposed to plan adequate and specific treatments for optimum plant formation (Romero Díaz et al., 2014).

4.4. Spanish National Agri-environmental Program (SAEM)

Agri-environmental Measures (AEM) finance the voluntary adoption of environmental practices related to the preservation of the environment and maintaining the countryside (EC, 2015). It is a key element of the EU to make agricultural production and environmental conservation compatible (Calatrava, 2008). Since 1992, the application of AEM has been compulsory for member states although they may determine their own norms and standards. Spain adopted the Spanish agri-environmental program in 1995 as a part of the rural development plan (RDP) (Stavi & Lal, 2015). AEM is one of the seven specific schemes (as can be seen in Appendix) of the RDP an is aligned with the Code of good agricultural practice (Calatrava, 2008).

Farmers can apply, on a voluntary basis, to requirements for a 1-plus-5 year period (1 for non-productive investments and 5 for farming practices) which offer opportunities for the buildup of soil organic matter; the enhancement of soil biodiversity; and the reduction of soil erosion (Calatrava et al., 2011). Additionally, agri-environment schemes have marginal to moderately positive effects on biodiversity (Kleijn et al., 2006).

Regional governments are responsible to implement the schemes (Oñate et al., 1998). The process of applications, payments and monitoring are a task for the departments of the regional governments. However, definitions of responsibilities for the regional authorities are poor defined, causing conflicts and confusion.

Schemes are co-financed on a 50-50 basis by the EU and National funds (Peco et al., 2000). The amount made available by the European Agricultural Fund for Rural Development for the period 2007-2013 can be seen in Appendix VI (EC, 2014). However, nothing is mentioned about the costs.

The role of stakeholders were identified. Farmers' organizations were strong supporters of these schemes as they interpreted these as direct subsidies, but the involvement of environmental NGOs, state environment agencies, experts, research institutes and universities was limited and they did not take part in the policy-making process (Peco et al., 2000; Calatrava et al., 2011). The main reason for farmers to participate are obviously the financial incentives, but the farmers are generally aware of the soil conservation objectives, the strictness of the control system and the sanctions (Calatrava et al., 2011; Peco et al., 2000). Controls are conducted directly by the European Commission (EC) and the monitoring consists of exante evaluation, midterm evaluation and expost evaluation (Peco et al., 2000; Calatrava, 2008).

5. Policies in Murcia

5.1. Regional Agri-environmental Program (RAEM)

Prescriptions for individual measures for the AEM scheme are designed by the Agriculture Department of the Murcia Regional Government (Calatrava, 2008). The general aim is to preserve ecosystems and biodiversity, recovering and/or maintaining soil fertility and organic matter content, obtaining crops with less chemical residues, and reducing chemical pollution from agricultural sources in air, water and soils (DGVI, n.d.). AEMs in the Murcia region were redesigned for the 2007-2013 period because the soil erosion AEM at the national level was not fully suitable for the Murcia region (Calatrava et al., 2011). Agricultural organizations and academic experts are consulted but do not have a great capacity to influence the design. The new measure is more technically complex, but offers higher payments in exchange (Calatrava, 2008). Payments increased, but less farmers will be able to benefit. The main drawback of the AEMs are the low payments, the lack of technical advice regarding the required practices, and the complex and time-consuming bureaucracy, although farmers got help with the administrative burden from agricultural organizations (Calatrava et al., 2011).

Monitoring plans are well established and the reports are will be sent to the EC (DGVI, n.d.).

130 million euros have been made available for the agri-environment payments for 2007-2013 in Murcia, which was funded by the European Agricultural Fund for Rural Development, supplemented by Spain (Appendix VII) (ENRD, 2013).

5.2. Hydrological Restoration Plans (HRP)

The Forest Strategy of the Murcia Region, which is part of the Plans for the Management of Forest Resources (PORF), uses agri-hydrological activities to restore the vegetation cover to protect the soil and the hydrological cycle (Serrano, 2004). Actions include the installation of a protective vegetation cover, silvicultural treatment for improving degraded vegetation cover and the building and maintenance of hydraulic structures (Romero Díaz et al., 2014). However, land under public management to implement these actions is very scarce. Therefore the regional administration designed tools to promote restoration in private lands, in which the requirements of the agricultural and forest administrations are aligned. Additionally, the administration purchases land, which almost amounted 8.000 hectares (Serrano, 2004).

The contribution of the Central Government is facilitated through the agreements with the State Biodiversity Office and through the water and forest policies. Besides, the River Basin Authorities and the regional administration signed agreements for the HRP in 2001. Furthermore, within the planning tasks, participation of professional forest and agricultural organizations, rural development stakeholders are taken into account (Serrano, 2004).

In order to achieve financial support, the regional administration acknowledged to support awareness-raising to foster the idea that the whole society should focus on the long-term benefits of agri-hydrological activities. All proposed action plans will be co-financed with European Regional Development funds and the EU funds within the RDF-framework (Romero Díaz et al., 2014).

Within Murcia, the RHP has been implemented widely. However, research and experimentation in the field of bio-engineering techniques and plant genetics should be fostered to enhance implementation. The cooperation between research groups and private entities is facilitated by demonstrative projects in which they both participate (Serrano, 2004).

6. Challenges and opportunities

According to the policy descriptions, the presence of the criteria are identified and presented in the tables below (columns indicate policy-aspects, represented by their number which can be found next to the tables; the rows indicate policy-measures). The presence of criteria implies a opportunity, an absence implies a challenge. For each aspect, opportunities and challenges will be further elaborated.

6.1. Organizing

As can be seen in table 1, the policy makers gave no attention to criteria 5,6,7 and 8. These actions are necessary to organize support of stakeholders and to raise awareness among them. But first, the relevant stakeholders need to be identified, which was not on the agenda for two policies. Also plans for the involvement of key participants, scientists and technical people were lacking for two policies.

Table 1: Organizing

	1	2	3	4	5	6	7	8
4.1	X	X	X	X				
4.2	X	X	X					
4.3	X	X		X				
4.4		X	X					
5.1		X		X				
5.2	X	X	X	X				

1: Convinced participants, 2: political support, 3:identified stakeholders, 4: involvement of scientists and technical people, 5: enlistment of champions, 6: use of events as opportunities, 7: obtainment of seed money, 8: building on successful pilots

6.2. Governing

As can be seen in table 2, only 3 policy plans adopted formal agreements, which are useful to commit parties to goals. Overall, policy makers gave little attention to the structure of the policies, as formal agreements and commissions are generally lacking. In contrast, the federal and state roles are well identified. The NAP can be seen as a facilitator between all other policies, although facilitators with other stakeholders are generally lacking.

Table 2: Governing

	1	2	3	4	5
4.1		X	X	X	X
4.2	X		X		X
4.3	X		X		
4.4	X		X		X
5.1			X	X	X
5.2			X		

1: Adoption of agreements, 2: establishment of commissions, 3:identified federal and state roles, 4:the use of facilitators, 5: the adoption of conduct codes

6.3. Planning

As can be seen in table 3, a lot of criteria are not incorporated in the policy plans. The goals are, more or less, the same for all policies; combatting DLDD and the improvement of biodiversity. However, measurable outcomes are generally lacking, even though some actions are selected. To make ZNLD operational, a plan of action is required (Chasek et al., 2015). However, the underlying factors for the development of such a plan to achieve the goals are missing, as the policies generally lack plans for defined ecosystem concerns and necessary science, accurately calculated costs, allocated responsibilities (except for the NAP, PNAP and SAEM), criteria to prioritize actions, a user-friendly-plan and organizational commitments (except for the NAP and SNFP). The lack of a well formulated and well-developed plan is not only a problem in Spain, but is recognized to be a problem in general

(UNCCD a, 2013). ZNLD is only an instrument, lacking concrete steps for implementation. The task of setting specific standards and strategies is left over for national authorities which has not yet been reached in many countries (UNCCD a, 2013).

Table 3: Planning

	1	2	3	4	5	6	7	8	9	10	11
4.1		X	X	X				X	X		X
4.2	X	X	X	X	X						X
4.3	X		X	X	X		X	X	X		
4.4			X	X	X			X			
5.1	X		X	X	X						
5.2			X	X							

1: Defined ecosystem concerns, 2: necessary science, 3: determined goals, 4: consensus throughout the system, 5: selection of actions and measurable outcomes, 6: considered effects of self-repair, 7: accurately calculated costs, 8: allocated responsibilities, 9: established criteria to prioritize actions, 10: a user-friendly-plan, 11: organizational commitments

6.4. Implementing

As can be seen in table 4, all policy makers recognized the importance of financial support by the incorporation of financial resources. However, these funds are perceived as a limiting factor, because of the insufficient amount (Nkonya & Anderson, 2015). Scientific expertise is necessary to create models and case-by-case strategies. But a plan to obtain scientific expertise is limited, as well as the development of models that approximate the natural world that could speed and test planned projects (Vigmostad et al., 2005). Although the purpose of decentralization to adopt localized strategies, only RAEM adopted plans for case-by-case strategies.

Table 4: Implementing

	1	2	3	4	5
4.1	X	X	X		
4.2	X		X		
4.3	X		X		X
4.4	X		X		X
5.1	X		X		X
5.2	X	X	X		

1: A mix of financial support 2: necessary scientific expertise and technology 3: strengthened monitoring programs 4: models 5: case-by-case strategies

6.4.1. Securing funds

Although the UNCCD recommend policy makers to integrate economic, social and environmental costs, the incorporation of these costs into national and regional policies is limited (UNCCD b, 2013). Also the elaboration of benefits and impacts are not well-considered. National, bilateral and multilateral resources are incorporated, but the funds made available are generally not sufficient (UNCCD c, 2012). These resources could be completed by payments for ecosystem services, but none of the policies took this source in consideration.

Table 5:Securing Funds

	1	2	3	4	5	6	7
4.1							
4.2				X	X	X	
4.3	X			X	X	X	
4.4				X	X	X	
5.1				X	X	X	
5.2		X		X	X	X	

1: Costs, 2: benefits, 3: impacts, 4:National resources, 5: bilateral resources, 6: multilateral resources, 7: Payment for ecosystem services

6.5. Accounting

Policy makers not only gave little attention to the calculation of costs, also the projecting and tracking expenses as a form of accounting received little attention, as can be seen in table 6. The lack of effective accounting systems will not ensure economic, ecological, and public accountability. But some policies incorporated awareness rising, which will enhance public accountability. Besides, developments of restoration practices are not yet evaluated, although the monitoring plans are well-elaborated.

Table 6: Accounting

	1	2	3	4	5
4.1					
4.2	X				
4.3					
4.4	X				
5.1	X				
5.2					

1: Mandatory and voluntary enforcement 2: evaluated outcomes accounted for external stressors 3: the publication of interim results based on what the public cares about 4: public assessment of progress and success 5: recognizing and rewarding of champions

6.6. Outcomes

According to the outcomes of table 1 to 6, the absence of factors of organizing and accounting seems to be the most problematic. However, not all the criteria are of equal importance. The absence of several aspects are more problematic than others. The absent criteria of the planning and implementing aspects can be considered as more important, as they form the base of one of the key-actions[10] which are regarded as necessary by the UNCCD (UNCCD a, 2013).

At the global level, limiting factors of the past included insufficient funds, a weak scientific basis, insufficient awareness, inadequate legal basis and institutional weakness. As can be concluded from the policy analyses, plans for a sufficient scientific basis, sufficient awareness and strong institutions are still not incorporated in the national and regional policy developments and still form a challenge.

On the other hand, also opportunities exist. Main opportunities include political support, identified federal and state roles which is part of creating a policy structure, general aims and goals, consensus throughout the system, the existence of some financial support, and the well-elaborated monitoring plans.

[10] Key action B: Set up national goal and targets, support regional, and sub-national level goals and targets.

7. Conclusion and policy recommendations

The UN recognized the importance of problems of drought and set up a strategy to combat the underlying causes. This strategy is based on the method of ecological restoration and need to be a top priority of all national policies. Also in Spain, the effects of drought are becoming more visible. However, the effectiveness of policies containing ecological restoration is limited, both at the national and regional level. Therefore, this paper examined the opportunities and challenges for the successful implementation of ecological restoration at the national and regional level in Spain. Both opportunities and challenges exist at the levels of organizing, governing, planning, implementing and accounting. Although some opportunities exist, these are currently overruled by the existence of challenges. The most important challenge for all policies is the lack of a well-developed plan with well-elaborated measures. This is partly due to a lack of determined goals and measurable outcomes and partly due to the incomplete policy structure which lacks formal agreements and commissions. Another important factor is the lack of involvement of stakeholders, scientists, experts and technical people. This causes both a lack of sufficient awareness due to a lack of stakeholder support and a lack of a scientific basis. Another challenge includes insufficient funds, which is due to a lack of accurately calculated costs, benefits and impacts and the lack of the incorporation of payment of ecosystems. Moreover, not only the costs are not accurately calculated, the whole plans for an accounting system are missing which will result in a lack of economic, ecological, and public accountability.

In order to improve the effectiveness of the national and regional policies containing ecological restorations, policy makers need to take these challenges in consideration. In short, they need to develop a well-elaborated, science-based plan with measurable outcomes and a complete policy-structure.

8. Discussion

Even with some interesting findings, this study has its limitations. First, in order to identify the challenges and opportunities, a framework is used based on the findings of Vigmostad et al (2005). This framework is not yet used by other scientists to identify challenges and opportunities for practices of ecological restoration, although some researchers used parts of the lessons learned by Vigmostad et al. Therefore, the completeness of the framework is not yet criticized. For that reason, it cannot be said with certainty that the criteria of the framework are all-encompassing. Second, in the analysis of some policies, policy summaries are used. As a result, some interesting information might be lost. Consequently, it cannot be stated with certainty that all challenges have been identified.

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10. Appendix

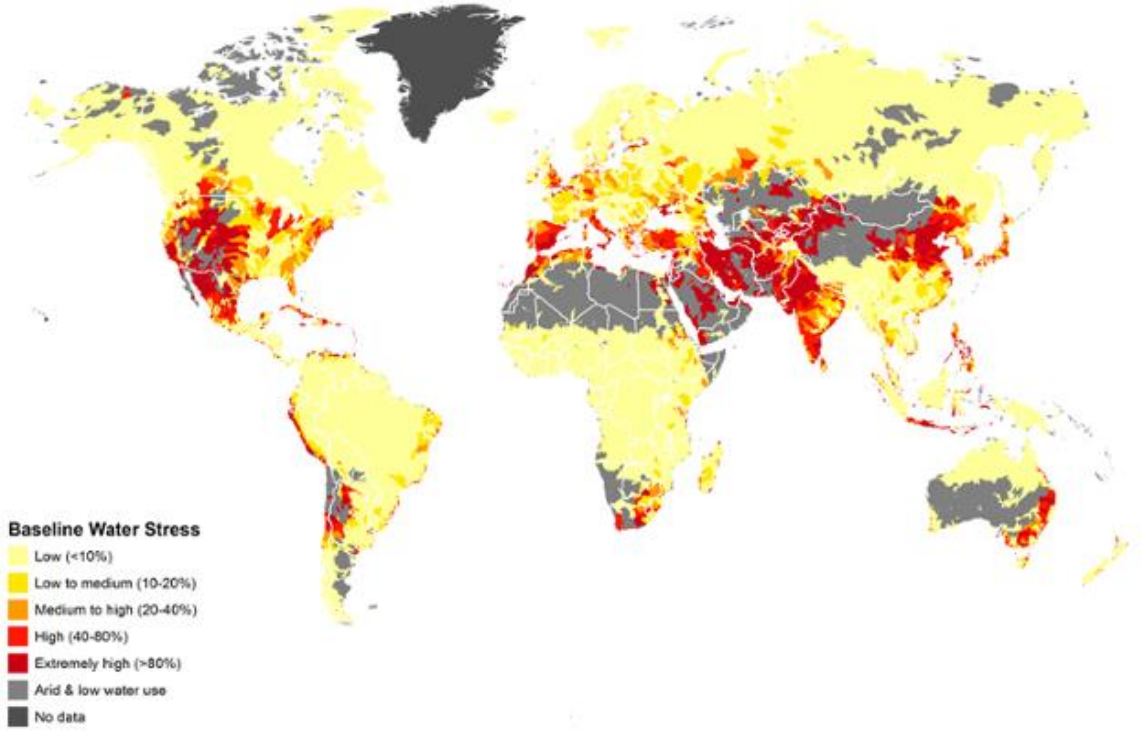
I Background information about the UNCCD and ZNLD

The United Nations Convention to Combat Desertification (UNCCD), established in 1994, is an international community to commit itself to a land degradation neutral world by setting sustainable development goals on land use, with targets towards achieving zero net land degradation (ZNLD). The strategy of ZNLD was established in 2007 and contains two complementary mechanisms: avoiding degradation by appropriate management of currently non-degraded lands, and at the same time, restoring already-degraded lands (Gnacadja & Stringer, 2012). However, ZNLD is just a protocol and must be filled in by the national authorities. Therefore, National Action Programs (NAPs) are key instruments to implement the convention. NAPs are developed through a participatory approach involving relevant governmental offices, scientific institutions and local communities. Parliaments can actively contribute to the implementation of the UNCCD by law-making, budget allocation, oversight, awareness raising, election of competent personalities and bodies and international cooperation and networking (UN, 2013).

Already 196 countries signed the convention. Signatories need to ratify the convention to bring it into force. All measures provided in the convention are legally binding for all signatory states. The population of these states can thus demand compliance. However, no sanctions for non-compliance exists. Non-signatory States have the option of acceding the convention at any time.

In short, the convention simply lays out a political strategy without verifiable criteria for success. Therefore, the success of the convention depends largely on the efforts of the member states (BMZ, 2015).

II Water stress around the world



Source: WRI, 2015

III Land Degradation and Climate Change

Source: UNCCD, n.d.

IV Spanish policies concerning drought issues

Name	Ecological Restoration	Level	Aspects
1985 Water Act		Spain	All water resources, surface and discovered or undiscovered ground waters, are public goods. Water uses become determined by the regulation of aquifer overexploitation, critical drought conditions or other limitations in the general use of water public domain (Costejà et al., 2002).
National Irrigation Plan and Emergency Plan for Modernization of Irrigation		Spain	The improvement of agricultural water management to increase crop productivity, reduce the influence of drought and promoting water conservation is one of the main objectives of current irrigated agriculture in Spain (Rodriguez-Díaz et al., 2011).
The National Strategy for Sustainable Irrigation Modernization		Spain	Aims to continue efforts to improve water management and promote sustainability of irrigation by pursuing energy efficiency (Rodriguez-Díaz et al., 2011).
Law 9/1996 on urgent measures to ameliorate the consequences of drought		Spain	Adoption of emergency measures to mitigate drought effects (Cardwell, 2004).
National Drought Indicator System		Spain	Precipitation in the last periods, water reserves stored in the reservoirs, and level of aquifers are periodically monitored in order to foresee the beginning of a drought and to predict its development phase (UC Riverside, 2010).
Drought Management Plan		Spain	The main objective of these management plans, devised by basin authorities is to minimize the environmental, economic, and social impact of drought situations. The plans also include

			exploitation rules and measures to be implemented according to the severity of the drought (UC Riverside, 2010).
Hydrologic Plan Act		Spain	An intensive planning approach by controlling water resources through hydraulic infrastructures (e.g. dams and channels) (UC Riverside, 2010).
National Action Plan to Combat Desertification	X	Spain	It is the duty of the Ministry of the Environment, in collaboration with the Ministry of Agriculture, Fisheries and Food to implement sustainable development policies and the policies of integrating of the environment within several sectoral policies (UNCCD, 2006). Its objectives are to contribute to the sustainable development of arid, semi-arid and sub humid zones; to prevent and reduce soil degradation; and to restore areas affected by desertification (Zanolla et al., n.d.).
National Plan of Priority Actions for Hydrological Forest Recovery and Erosion Control (PNAP)	X	Spain	Its objective is to maintain and improve the protective function of forests for soil and water resources to control erosion and improve the water system (Eritja et al., 2011)
Spanish National Agri-envrionmental Program	X	Spain	This program includes a subprogram with four horizontal schemes (extensification, organic farming, breed and strain preservation, and agri-environmental training). Although it was passed by the National Parliament in 1995, the program also requires each Regional Government to produce specific legislation for its application (Oñate et al., 2000).
National Action Program to fight Desertification		Spain	This program specifies geographic areas in risk of desertification, as well as the identifying factors leading to desertification and the means to fight desertification and drought by laying the foundations to coordinate thematic actions, propose an institutional framework for its development at national level; the establishment of an economic reference framework in the medium term for the fight against desertification (Minestrio de medio ambiente, 2001).
Strategy for conservation and Sustainable use of Biodiversity		Spain	One of the five main objections is to include the principles of restoration, conservation and sustainable use of biological diversity in the planning and execution of sector and cross-sector policies. The problem of erosion is recognized, the opportunities of abandoned land are mentioned, but restoration practices are not explicitly defined. The focus is on species, while the importance of healthy soil is largely ignored. (Minestrio de medio ambiente, 2001).
Reforestation Plan	X	Spain	The project is part of LIFE+ and its main objective is to demonstrate the feasibility and effectiveness of new tree planting techniques in desertified, poor and/or rocky areas. Innovative 'Waterboxx' technology (Twinboxx) will be applied to restore the sponge-function of degraded soils and reinforce soils' existing capacity for supporting plant life (Groasis Tech, 2015).
Project to fight Desertification in the Mediterranean	X	Spain	The project aimed to analyze the varied resources and factors involved in desertification processes; to determine means and techniques to fight

			desertification and to undertake integrated planning of preventive and restoration actions in affected torrential river basins; and to provide education and training and to disseminate the project issues among involved experts and local populations (Wilson & Juntti, 2005).
Royal Decree Law 8/1993		Spain	Adoption of emergency measures to mitigate drought effects (Garrido et al., 2003).
Royal Decree Law 7/1995		Spain	Approval of the transfer of 55hm to the Segura Basin and of the financing of emergency works to face drought situation (Garrido et al., 2003).
Royal Decree Law 20/1999		Spain	Adopting new measures to mitigate the effects of drought on woody crops (Garrido et al., 2003).
Regional Agri-environmental Program (Reg. EEC/2078/92)	X	Murcia	Measures for dry land erosion combat, cereal extensification, organic farming, integrated pest control and education and training. The number of applications (approximately 5000 farmers) has surpassed expectations and all measures include a compulsory code of good agricultural practice (Peco et al., 2000).
Hydrological Plans	X	Murcia	Uses agri-hydrological to plan activities to restore the vegetation cover to protect the soil and the hydrological cycle (Serrano, 2004).
PORF	X	Murcia	instruments of forestry planning at regional scope, and they are integrated in territory management, staying connected planning and management of forest within general territory management (Proforbiomed, 2013).

V Hydrological-Forest Restoration Actions in Spain

Year	Reafforested surface Has	Hydrotechniques m^3	Silvicultural treatments Has	Total investment Million pesetas
1997	10.441	71.434	71.434	5.827,0
1998	7.961	92.124	92.124	5.023,2
1999	7.008	50.157	50.157	5.112,7
2000	3.882	43.256	43.256	4.321,5
2001	2.415	226.019	226.019	2.802,6
2002	2.507	49.314	8.850	3.626,7

Source: Eritja et al., 2011

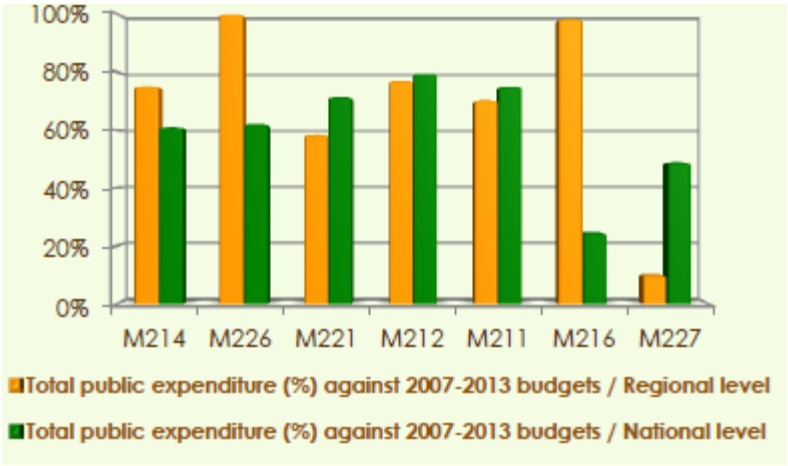
VI State of the Total Public and EAFRD expenditure per measure

Measure	Description	Realised 2007-2008-2009-2010-2011-2012-2013		Programmed 2007-2013*		EAFRD: % on target	Total Public: % on target
		EAFRD	Total Public	EAFRD	Total Public		
211	Natural handicap payments to farmers in mountain areas	251,735,794.38	447,929,918.90	283,923,806.00	499,745,110.00	88.7%	89.6%
212	Payments to farmers in areas with handicaps, other than mountain areas	209,565,717.68	405,367,663.66	248,602,521.00	457,966,207.00	84.3%	88.5%
213	Natura 2000 payments and payments linked to Directive 2000/60/EC	3,960,800.31	5,543,464.07	4,271,589.00	6,108,344.00	92.7%	90.8%
214	Agri-environment payments	1,216,003,577.83	1,949,087,232.91	1,574,354,716.00	2,466,819,321.00	77.2%	79.0%
215	Animal welfare payments	16,730,805.44	40,643,441.35	34,799,854.00	74,264,590.00	48.1%	54.7%
216	Non-productive investments	9,093,053.97	15,190,643.12	16,279,027.00	26,008,947.00	55.9%	58.4%
221	First afforestation of agricultural land	313,912,497.52	543,275,960.44	385,868,687.00	616,214,331.00	81.4%	88.2%
222	First establishment of agroforestry systems on agricultural land	0	0	0	0	-	-
223	First afforestation of non-agricultural land	35,972,122.05	58,573,354.08	68,013,228.00	100,776,309.00	52.9%	58.1%
224	Natura 2000 payments	0	0	0	0	-	-
225	Forest-environment payments	10,639,731.04	25,002,185.05	13,698,208.00	30,565,906.00	77.7%	81.8%
226	Restoring forestry potential and introducing prevention actions	407,093,420.72	634,969,106.82	603,743,148.00	898,809,097.00	67.4%	70.6%
227	Non-productive investments	130,864,222.45	231,668,747.97	250,132,428.00	401,254,423.00	52.3%	57.7%
		2,605,571,743.39	**4,357,251,718.37**	**3,483,687,212.00**	**5,578,532,585.00**	**74.8%**	**78.1%**

Source: European Commission, 2014

VII Total public expenditure (2007-2012) against 2007-2013 budgets

The rural development plan has seven specific schemes: restoring forestry potential and introducing prevention actions (M226), non-productive investments in agriculture (M216), payments to farmers in areas with handicaps, other than mountain areas (M212), agri-environment payments (M214), natural handicap payments to farmers in mountain areas (M211), and afforestation of agricultural land (M221) (ENRD, 2013).



Source: European Network for Rural Development, 2013