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Desk Review Study on Employment Impact Assessment (EmpIA): Potential of Natural Resource Management (NRM) Investments on Employment Creation

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Preface

Employment is a key driver for development as it constitutes a bridge between economic growth and poverty reduction. People and households moving out of poverty most often do this through moving into more productive and decent jobs or improving existing jobs. Placing the aim of achieving full and productive employment at the heart of development policy is therefore critical for reducing and eventually eliminating poverty, reducing inequality and addressing informality. This is also now globally recognized with the adoption of Sustainable Development Goal (SDG) 8 "Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all"

The European Commission (EC) and the International Labour Organization (ILO) recognize that achieving this goal will require an approach where the goal of more and better jobs is also integrated into sectoral and trade policies. However, this requires a shared understanding among policymakers and social partners about the positive interaction between sectoral, trade and employment policies and the elaboration of a policy framework allowing sectoral and trade policies to be formulated and implemented in a coherent way to achieve employment and development objectives.

The ILO clearly recognizes that putting the aim of full and productive employment at the heart of development policy is critical in creating decent work and fostering social justice. These perspectives reflect a commitment to the objective of creating quality jobs globally and to pursuing cooperative solutions to this challenge. In the "New European Consensus on Development", the EC emphasizes the importance of targeted policies and appropriate investment in developing countries to promote the engagement of citizens - especially the youth, women and potential migrants - in social, civic and economic life and to ensure their full contribution to inclusive growth and sustainable development. To this end, the EU External Investment Plan, adopted in 2017, is trying to mobilize and leverage sustainable public and private investments to improve economic and social development with a particular focus on decent job creation.

In order to build a shared understanding among policymakers through policy dialogue and contribute to a coherent policy framework that is centered on generating and upgrading employment, the EC and ILO have jointly initiated the project entitled "Strengthening the Impact on Employment of Sector and Trade Policies". This project, being implemented in nine partner countries and working with national governments and social partners, aims to strengthen the capabilities of country partners to analyze and design sectoral and trade policies and programmes that would enhance employment creation in terms of quantity and quality.

This innovative project entails developing new methods and capacities to assess how sectoral and trade policies impact on both the qualitative and quantitative dimensions of employment. It requires new processes to bring together different Ministries, public and private stakeholders to have evidence-based dialogue about how their respective policies do, and could, better impact on employment.

This series of project publications aims to capture the tools, methods, and processes developed under this project, as well as the findings from implementing these in the ten partner countries. By doing so, the experience and learning of the project can be

disseminated to other countries and partners for their benefit, thus supporting the integration of global and national employment objectives into sectoral and trade policies and consequently supporting the elevation of the global employment agenda and achievement of SDG 8.

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Abbreviations

EPWP	Expanded Public Works Programme (South Africa)
FAO	Food and Agricultural Organization of the United Nations
FSC	Forest Stewardship Council
FTE	Full-Time Equivalent (employment)
IAS	Invasive Alien Species
ICLS	International Conference of Labour Statisticians
IIED	International Institute for Environment and Development
ILM	Integrated Landscape Management
ILO	International Labour Organization
IUCN	International Union for the Conservation of Nature
LDC	Least Developed Counties
IWRM	Integrated Water Resources Management
MDB	Multilateral Development Bank
MENA	Middle East and North Africa
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act (India)
NRM	Natural resource management
NTFP	Non-Timber Forest Product
PA	Protected Area
PEFC	Programme for the Endorsement of Forest Certification
PES	Payment for Ecosystem Services
PSNP	Productive Safety Net Program (Ethiopia)
REDD	Reducing Emissions from Deforestation and forest Degradation
SCPI	Sustainable Crop Production Intensification
SDG	Sustainable Development Goal
SEEA	System of Environmental-Economic Accounting
SAM	Social Accounting Matrix
SFM	Sustainable Forest Management
SWC	Soil and water conservation
UN	United Nations
UNEP	United Nations Environmental Program
WESO	World Economic and Social Outlook
WfW	Working for Water (South Africa)
WWF	World Wildlife Fund

1. Introduction

Even as environmental and climate change concerns rise to unprecedented levels, urgent social and economic challenges remain prominent in policymakers and the general public minds. Although the interdependence between healthy ecosystems and human well-being is becoming increasingly clear, it remains insufficiently acknowledged and integrated into economic, social and environmental policies. Until recently, internalizing this interdependence has been delayed, and at best treated as a long-term goal. Too many policies and debates are still based on the assumption that there is a necessary trade-off between human well-being on the one hand, and a thriving natural world on the other. Such posture is no longer possible. All scientific evidence and projections point to how essential it is to drastically reduce carbon emissions, losses in biodiversity, soil erosion and degradation, deforestation, overfishing and pollution of surface and ground water within the next decade.

These reductions will require the mobilization of public and political support and will need to be accompanied by massive investments. Investments required to shift energy production away from fossil fuels have so far captured most attention from policymakers and the public, but they are only one term of the equation. Of equal importance will be the implementation of a sound Natural Resources Management (NRM) approach, which is required to restore and protect the natural world so as to ensure it continues to provide the ecosystem services on which we depend, and by the same token provide the basis for the creation of durable jobs. However, most development agencies and organizations still place little emphasis on the employment implications of the NRM policies they are advocating.

From the ILO's perspective, with its mandate of promoting full-employment, the demonstration that appropriate NRM can result in large-scale job creation is most relevant, as it will build support among stakeholders whose concerns and focus lie more in the social and economic, rather than environmental realm. Indeed, while the size of the world economic product (global GDP) has more than tripled since 1990, securing adequate and decent employment for all and promoting a just transition towards an environmentally sustainable economy remain among the biggest challenges for policy-makers. Thus investments that stimulate employment creation will continue to gain keen interest, in particular in the aftermath of the COVID 19 pandemic. The global crisis triggered by the COVID19 pandemic may also dramatically shift the perspective on the importance of NRM since there is mounting evidence that this and other emergent diseases are related to man-induced degradation of natural habitats.

This review - by highlighting the employment effects of investments in sound NRM - aims at contributing to the mobilization of the political will and resources needed for these investments to materialize.

1.1 The nexus of Natural Resource Management, ecosystems services and employment

The availability of natural resources[1] remains a key parameter for production in the primary and secondary sectors of the economy, and thus lies at the origin of the lion's share of jobs, particularly in developing countries. Their extraction and use directly affect the sustainability and productivity, and thus employment potential, of sectors such as agriculture, mining, tourism, fisheries and forestry. For instance, the 2016 World Water Development Report on "Water and jobs", contends that 1.4 billion people - over half of the world's workers- are employed in heavily water-dependent jobs, while an additional 1.2 billion jobs are moderately water-dependent (WWAP 2016). Similarly, the ILO in its 2018 WESO report (ILO 2018) estimated that 1.2 billion jobs or 40 per cent of total global employment currently depend on ecosystem services[2]. Sound and sustainable NRM is critical for enabling ecosystems to continue providing these services and is thus essential for maintaining employment across the globe.

Although the shares of the primary sector, which is most dependent on ecosystem services, has been rapidly decreasing in the richer countries both in the GDP and in the workforce, the picture is significantly different in low-income countries, where they also have a smaller proportion of GDP but retain a large share of the workforce (Figure 1).

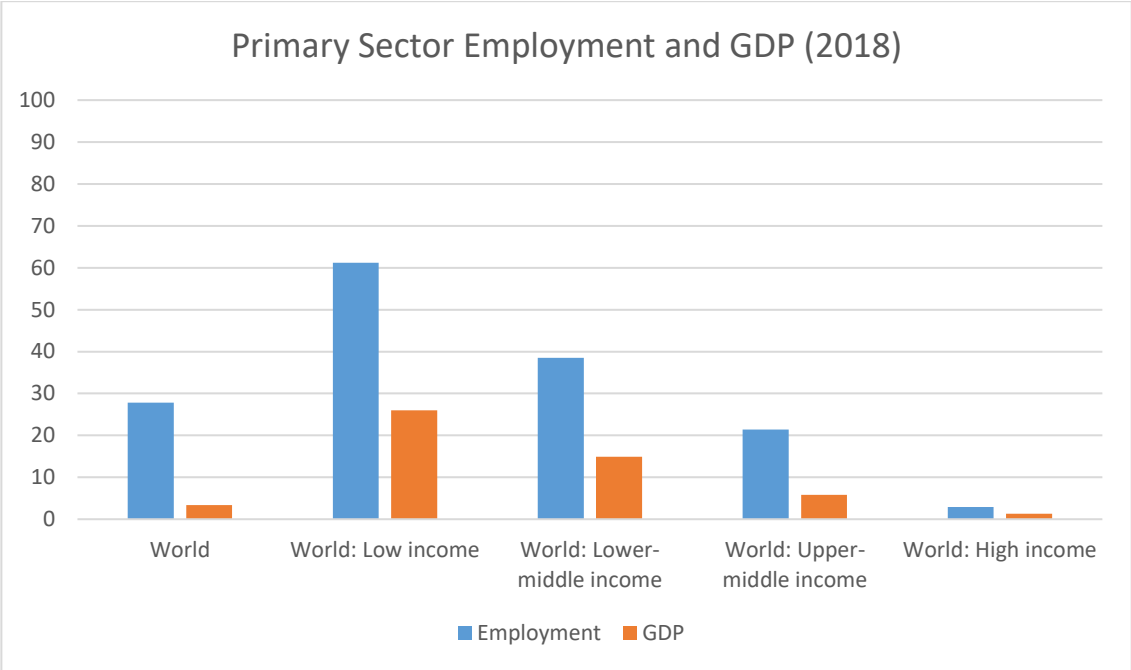
Looking forward, over the next decade an additional 600 million new jobs will be needed to absorb burgeoning working-age populations, mainly in Asia and Sub-Saharan Africa[3]. Decent jobs are critical for reducing poverty and promoting prosperity; all countries, regardless of income, face challenges creating and sustaining adequate job opportunities for their citizens. Today, large-scale unemployment and underemployment are widespread in developing countries[4]. Ensuring a fair, inclusive and secure future of work is fundamental for sustainable development that puts an end to poverty and leaves no one behind.[5]

Self-employment and the private sector remain the key sources of jobs, accounting for 90 percent of all jobs in the developing world. Informality is widespread, with more than half of the workforce and 80 per cent of enterprises operating in the informal economy worldwide. However, governments do play a vital role by ensuring that the conditions are in place for strong private-sector led growth, by alleviating the constraints that may hinder

[1] In this review, the focus is on soil, water, animals and vegetation and excludes fisheries as well as minerals and fossil fuels, the extraction of which pose a specific set of issues.
[2] The term "ecosystem services" to designate the benefits gained by humans from ecosystems, was popularized by The Millennium Ecosystem Assessment (MEA) (UNEP 2005) a major assessment of the human impact on the environment.
[3] World Bank 2013
[4] Together the unemployed and underemployed amount to 1 in 3 of the world's workers, UNEP/ILO/IOE/ITUC 2008.
[5] ILO Centenary Declaration for the Future of Work, 2019, https://www.ilo.org/wcmsp5/groups/public/@ed_norm/@relconf/documents/meetingdocument/wcms_711674.pdf

private initiatives and incentivizing the creation of decent[6] jobs. Besides, it is a common fact that when times are bad, people turn their dissatisfaction to governments and expect them to "create jobs".

Figure 1: Share of Employment and GDP



Source: Compiled from ILO Stat and World Bank data

However, rather than investigating to what extent jobs depend on ecosystems services, we intend to explore the relationship from the perspective of how the NRM activities required to sustain ecosystem services directly generate employment. Only piecemeal work has been done in this area, and this review aims to lay the groundwork for more extensive and systematic investigation on the topic.

The review was conducted as part of the joint EU/ILO STRENGTHEN project, one component of which focuses on advocating the use of Employment Impact Assessments in order to systematically appraise the effects of investments on employment. Such assessments can be used to promote and maximize employment creation. While the project selected specific sectors of the economy, the challenge when dealing with NRM is that it cuts across many sectors, which may be one of the reasons why it is receiving little attention from an employment perspective. Indeed, employment statistics are typically broken down by the various sectors of the economy and thus NRM related activities do not show up in

[6] The ILO defined decent work as: "Work that is productive and delivers a fair income, security in the workplace and social protection for families, better prospects for personal development and social integration, freedom for people to express their concerns, organize and participate in the decisions that affect their lives and equality of opportunity and treatment for all women and men" (See https://www.ilo.org/global/topics/decent-work/lang--en/index.htm)

these figures. This review highlights that even though NRM is generally not viewed as a separate "sector", it has considerable bearing on employment. Such working hypothesis is consistent with the wide range of recent work done to understand, measure and demonstrate the importance of nature and ecosystems for the economy. This includes the adoption of the System of Environmental Economic Accounting (SEEA) Central Framework by the UN in 2012, the adoption of the "*Guidelines concerning a statistical definition of employment in environmental sector"* at the International Conference of Labour Statisticians (ICLS) in 2013 (See Box 2) as well as other work done by ILO and other organizations (ILO 2012, Conner 2014, ILO 2018 and Johnson et. al. 2020).

The underlying assumption therefore is that there is a large latent demand for labour inputs into NRM. Much of it is hidden because it is diluted into some "classical" sector (for example agriculture or tourism), or it is assumed that the labour can be done on a voluntary basis by rural communities – which more and more often is no longer valid. One aim of this review is to make this work demand more visible and attempt to quantify the labour inputs[7] that would be required to put in place a more comprehensive and sounder approach to NRM.

NRM here refers to the management and protection of ecosystems and natural resources such as land, water, soil, plants and animals, with a particular focus on how it affects the quality of life for both present and future generations[8]. It includes soil and water conservation and reforestation, which the ILO also refers to as "Green Works" (ILO 2011). Work in NRM brings together a range of disciplines and where employment in generated through these activities meets decent work conditions, it also creates Green Jobs (ILO 2012).

Promoting and implementing sound NRM requires a large array of specific skills and capacity development (of human resources and institutions) as well as the enforcement of a suitable regulatory framework at all levels. In a virtuous circle of job generation, more people need to be employed to help design and implement sound NRM, in order to create more and better natural- resource- supported and induced employment.

Box 1: The water-food-energy nexus: an emblematic example of NRM's influence on our well-being

Global projections indicate that demand for freshwater, energy and food will increase significantly over the next decades under the pressure of population growth and mobility, economic development, international trade, urbanization, diversifying diets, cultural and technological changes, and climate change.

Water is essential for agricultural production, forestry and fishery, along the entire agriculture-food supply chain, and it is also used to produce or transport energy in different forms. At the same time, the food production and supply chain consumes about 30 percent of total energy consumed globally (FAO 2011b). Energy is required to produce, transport and distribute food as well as to extract, pump, lift, collect, transport and treat water. Cities, industry and other users, too, claim increasingly more water, energy and land resources, and at the same time, face problems of environmental degradation and in some cases, resources scarcity.

[7] The unit most often for quantifying this labour inputs in this review is Full Time Equivalents (FTE), and is the equivalent of the time worked by a person who is employed full-time for a year.
[8] This formulation covers both environmental protection and resource management activities as used in the SEEA framework.

This situation is likely to be exacerbated in the near future: with the world's population set to rise to nine billion by 2050 from 7.3 billion today, food production will need to increase by 50 percent in order to feed the world population. Global energy consumption is projected to grow by up to 50 percent by 2035. Total global water withdrawals for irrigation are projected to increase by 10 percent by 2050 (FAO 2011).

The Water-Energy-Food Nexus has emerged as a useful concept to describe and address the complex and interrelated nature of our global resource systems, on which we depend to achieve different social, economic and environmental goals. With decent employment as an objective, it is necessary to have such a holistic view in addressing our needs: without food security[9], there is no competitively productive work. So ensuring food security, while using/degrading less water, energy and other natural resources, should be the primary concern of governments.

Source: FAO 2014

2. NRM and the job economy

2.1 Natural resources: An essential (albeit finite) source of goods and jobs

Human beings have no alternative to survive on the goods provided by nature; they have long been doing so, first as hunters/gatherers – a condition still a reality for millions - then as agriculturists, herders and fishermen. Until the industrial revolution, natural resources were the source of almost all goods and jobs. However, in the late 18th century, the first doubts started to emerge as to whether such exploitation could be continued forever, in view of the then incipient demographic growth. By 1972 , *The Limits to Growth*, a study of the patterns and dynamics of human presence on earth, commissioned by the Club of Rome, pointed toward environmental and economic collapse within a century if "business as usual" continued, giving rise to a worldwide controversy about the earth's capacity to withstand constant human and economic expansion. Then in 1987, the World Commission on Environment and Development report to the UN report entitled our "Our Common Future" coined "sustainable development "as a concept and a global objective. It sparked growing recognition that natural capital is finite and must be preserved for future generations, a viewpoint well captured in the reports foreword:

> "*Many critical survival issues are related to uneven development, poverty, and population growth. They all place unprecedented pressures on the planet's lands, waters, forests, and other natural resources, not least in the developing countries. The downward spiral of poverty and environmental degradation is a waste of opportunities and of resources. In particular, it is a waste of human resources. (…) What is needed now is a new era of economic growth - growth that is forceful and at the same time socially and environmentally sustainable."*[10]

[9] FAO (1996) defines food security as the state in which "all people at all times have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active, healthy life'. Food security has four dimensions, namely food availability, access, stability of supply, and utilization.

[10] Our Common Future, (a.k.a. the Brundtland report), report of the World Commission on Environment and Development, 1987. The report was written at a time when the world population was at 5 billion against over 7.6 billion today.

After this breakthrough, it became globally acknowledged that natural resources should be "sustainably" managed, rather than simply mined as they had been – and still are -in many places. However, even though the report helped build recognition of the threat posed to the environment, the link with employment was hardly touched upon - let alone analyzed. The report did mention basic facts such as:

> *"Agriculture, forestry, energy production, and mining generate at least half the gross national product of many developing countries and account for even larger shares of livelihoods and employment. (…)Most of these countries face enormous economic pressures, both international and domestic, to overexploit their environmental resource base" (chapter I, para 18)*

The globally agreed 2030 Agenda for Sustainable Development further emphasizes the importance of preserving and sustainably manage natural resources, and includes several Sustainable Development Goals with environment-specific targets and indicators. These include SDGs 6 on clean water and sanitation, 7 on affordable and clean energy, 12 on responsible consumption and production, 13 on climate action, 14 on life below water, and 15 on life on land. It also includes goals an employment and decent work in SDG 8.[11]

The ILO's 2018 WESO report aimed to quantify this dependence and estimated that globally 1.2 billion jobs depend directly or heavily on ecosystems services (ILO 2018). Almost 1 billion of these jobs are in the agriculture sector, with the remainder in the forestry, fisheries, wood and paper, tourism, textiles and chemical sectors. The bulk of the agriculture jobs are in the Asia Pacific and Africa regions.

The WESO report did not however quantify the labour requirements for implementing the various activities required for sustainable NRM. This knowledge gap persists, as is evident from the limited literature and academic work available on this topic. It is only recently, that the "people" dimensions are getting more attention by key conservation actors such as IUCN and WWF[12]. Yet even in their more recent strategies, the link to employment creation is still not well articulated.

How large the potential for employment creation through appropriate NRM is remains unclear, and while this review engages with this question, clearly more work remains to be done. Yet, there are sufficient indications that this potential is large enough to continue pursuing the investigation as some case studies reported in ANNEX 2 exemplify.

Box 2: System of Environmental-Economic Accounting and the measurement of employment in the environmental sector.

The System of Environmental-Economic Accounting (SEEA) is a framework that integrates economic and environmental data to provide a more comprehensive and multipurpose view of the interrelationships between the economy and the environment and the stocks and changes in stocks of environmental assets, as they bring benefits to humanity. The UN adopted the current central framework in 2012.

The framework has a classification of environmental activities (CEA) as follows:

[11] See https://sustainabledevelopment.un.org/?menu=1300

[12] For example IUCN now promotes the use of nature- based solutions for people and the planet, in recognition that a focus on conservation of the environment alone is not effective under many circumstances. https://www.iucn.org/theme/nature-based-solutions. WWF now also promotes a :"New Deal for Nature and People"

I: Environmental Protection (EP)
1 Protection of ambient air and climate
2 Waste water management
3 Waste management
4 Protection and remediation of soil, groundwater and surface water
5 Noise and vibration abatement (excluding workplace protection)
6 Protection of biodiversity and landscapes
7 Protection against radiation (excluding external safety)
8 Research and development for environmental protection
9 Other environmental protection activities

II: Resource Management (RM)
10 Management of mineral and energy resources
11 Management of timber resources
12 Management of aquatic resources
13 Management of other biological resources (excl. timber and aquatic resources)
14 Management of water resources
15 Research and development activities for resource management
16 Other resource management activities

The adoption of the SEEA also opened the door for improved measurements of employment in the environmental sector and related natural resource management activities. Guidelines were developed and adopted at the 19th ICLS in 2013. These follow the same structure as the SEEA and if used enable the categorization of certain types of employment as environmental sector employment. The framework does allow employment in the different activities discussed in this review to be classified, but this is not yet commonly done and employment data broken down into these categories is not yet available.

By 2017, 69 countries had adopted SEEA programmes and various projects are underway to develop elements of and guidelines for adopting the framework, and to support national statistical agencies to adopt the SEEA framework. This is an enormous task however and so far, data available is still limited.

Sources: seea.un.org, UN 2014, ILO 2013,

2.2 The rural economy, livelihoods and rural employment

The modern notion of employment and its indicators originated from industrial societies and has essentially been superimposed onto rural areas[13]. The notion of a full-time job with a stable employer who pays a stable salary is extremely rare in rural areas. For this reason, using standard employment indicators to assess the situation in rural areas can provide a distorted image. To address this, the "sustainable livelihoods approach" is often used in rural areas. This approach recognizes that people in rural areas are involved in multiple activities to make a living. For instance, as noted by Altman in the description of his proposed hybrid economics model, a member of an aboriginal community in Australia:

"... might participate in customary wildlife harvesting, the production of an artefact for market sale and in engagement with the state working-for-the-dole (under the

[13] This issue is now well recognized, and an important topic in labour statistics. See for example discussion at the 20th ICLS, https://www.ilo.org/wcmsp5/groups/public/---dgreports/---stat/documents/meetingdocument/wcms_636038.pdf

Community Development Employment Projects scheme) all on the same day."(Altman, 2007)

The challenge from an analytical perspective is of course how to disentangle this reality to be able to understand and measure the role, and relative importance of paid or wage employment. From a livelihood perspective, wage employment is an important diversifier, as it is low-risk as compared to other livelihood activities, in that income is immediate and there are no production or price risks involved. Paid NRM activities can play a critical role therefore in providing cash income, while at the same time supporting the feasibility of other livelihood strategies.

The approach taken in this review is to focus on the project and individual activity level and consider the person-days or years of work required for activities like afforestation or the protection of wildlife. How this labour demand will translate into jobs, will depend on many factors, including the structure of national and rural economies, local labour markets and institutions and will thus vary dramatically. In one country, these activities could be done on a voluntary basis, engaging people only a few days a year, while in others this could be done by employing people in full-time paid jobs.

Box 3: Volunteering, unpaid and paid work

An important policy question for NRM- related work is the basis on which this work is done. Volunteer work, unpaid work and paid work are all modalities that are common and have their place in the scheme of things. In some countries constituencies that are more affluent have displayed a higher degree of awareness on environmental issues and are thus willing to spend some of their time volunteering to do NRM activities. In the USA for example, the National Park Service receives millions of hours of voluntary labour inputs annually to support its conservation activities. Where people can afford to volunteer, and do not face a huge opportunity cost in volunteering, this approach should be encouraged.

However if poor or more vulnerable people are to be involved in NRM it is questionable whether they should be asked to volunteer. And if they end up doing related work without receiving any payment, whether this can more accurately be considered some form of unpaid work.

A common rationale for mobilizing poor people to contribute to NRM is that they will also reap some of the benefits. So in this sense fishermen may be asked to volunteer to restore mangrove areas as this will ultimately boost fish stocks and their incomes. Or small farmers may be asked to volunteer to work on soil and water conservation as this will also increase water availability for their farms. It is important that such approaches are properly questioned and discussed to ensure they are acceptable from a developmental and ethical perspective.

While people may agree to doing work without pay, they may do it because they feel compelled or forced to, because of peer pressure or the power structure in their community. While it may be true that some of the benefits of the activities may accrue to the people asked to volunteer, the work is in essence meant to enhance public goods that have much broader societal benefits and there is no reason why they would need to perform such work without pay. This would be akin to for instance asking a cleaner to clean the school his children attend for free as some of the benefits of the clean school accrue to members of his household. Expectations of that kind are not the norm in urban or more affluent societies and it is quite questionable whether it should be the case in poor rural areas.

Source: Authors

2.3 Agriculture, NRM and employment

Agriculture is mostly carried out by "family farms" worldwide. According to FAO (2013) at least 500 million of the world's estimated 570 million farms[14] are managed by families. Most of these farms are very small, with more than 475 million farms being less than 2 hectares in size (Lowder et. al. 2014). The regional distribution of farmland is also very uneven: in low-and lower middle-income countries as well as East Asia and the Pacific (excluding China), South Asia and in Sub-Saharan Africa, about 95 percent of farms are smaller than 5 hectares, and they entail the majority of agricultural land in those countries. In upper middle-income countries of Latin America and the Caribbean, Middle East and North Africa, the majority of farms are likewise smaller than 5 hectares in size, but they encompass less than 10 percent of farmland. In these countries 90 per cent of farmland belongs to large farms. This distribution is of particular relevance for NRM, as land is relatively more scarce for small farmers, and so they have a higher incentive to ensure that productivity per ha of land is maximized. Overall, family farming is estimated to provide employment for 40 percent of workers worldwide (Bélières et. al. 2015), with marked contrast between regions of the world: fewer than 5 percent of workers in North America and Europe are employed in agriculture compared to 27 percent in China, 43 percent in India and 54 percent in Africa. A considerable share of the farm workers worldwide (especially the landless) are underemployed and they experience the highest incidence of working poverty.[15].

Undoubtedly, higher GDP has been so far associated with a lower percentage of people working in the agriculture sector, a result of- amongst others- the mechanization in agriculture. Modern or "industrialized" farming is currently an activity generating few direct jobs, and has considerable negative effects on the condition of natural resources, in particular through pollution and deforestation[16]. Whereas industrialized farming has a much higher productivity than family farming per unit input of labour, this is often not true per unit of land. In a context where farmland is becoming increasingly scarce and labour more abundant, practices that emphasize increasing the productivity of land should therefore gain more prominence.

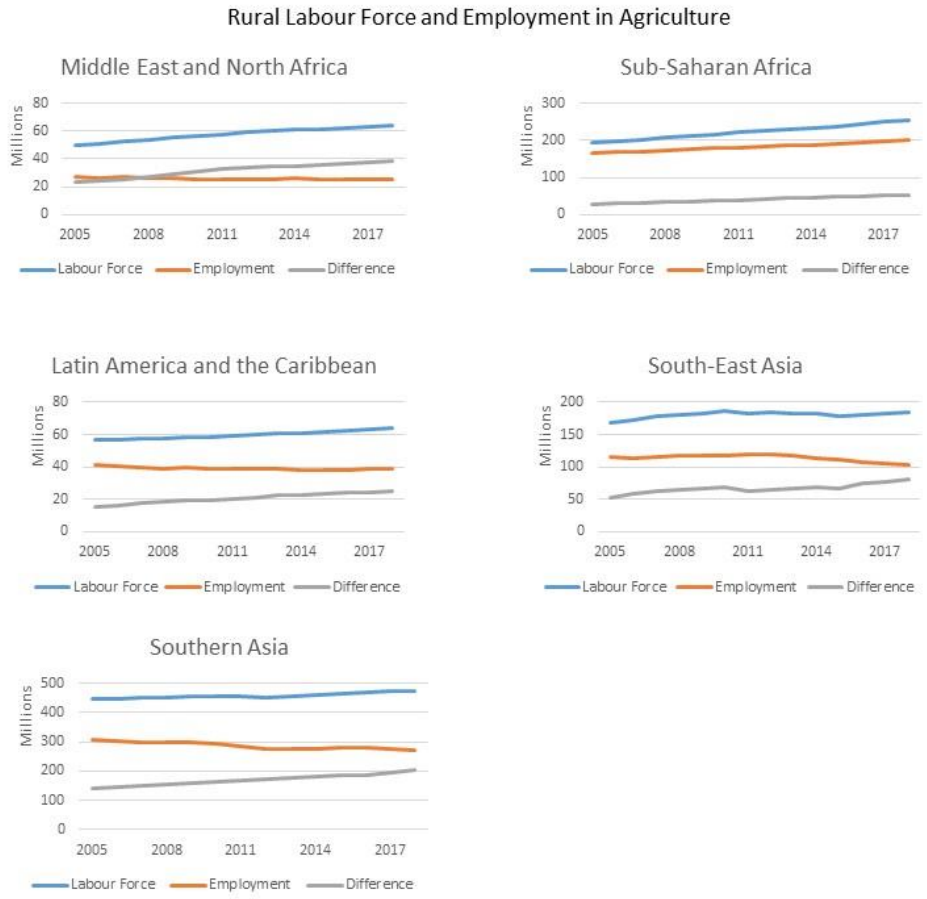
Over the last 15 years, in most developing countries the difference between the rural labour force and the number of people working in agricultural has continued to increase (Figure 2 below). This difference is most pronounced in the MENA region, which is also the region facing the most acute natural resources constraints for expanding agriculture. In quite a few low-income countries, many young people no longer see agriculture as an attractive option, and the viability of small family farms using current farming technologies and farm gate prices is diminishing. The effects of climate change further exacerbate this trend. This has led to the workers abandoning the agricultural sector at a rate greater than the rest of the economy can absorb them. Maintaining people in rural areas productive is a considerable challenge that requires boosting the income of small farmers and landless rural people, be it through improved productivity of their farming activities or otherwise providing them with work opportunities in managing and improving their environment both in agriculture and beyond in the diversified rural economies.

[14] Of which 60 percent in China and India alone

[15] ILO 2020. COVID-19 and the impact on agriculture and food security,
https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---
ector/documents/briefingnote/wcms_742023.pdf

[16]Large-scale soybean, oil palm plantations and ranching have been and still are responsible for the destruction of a considerable percentage of primary forests, particularly in the Brazilian Amazon, Indonesia and central Africa.

Figure 2. Rural labour force and employment in agriculture in selected regions



Source: Compiled from ILO Stats

Sustainable NRM has clearly become essential for maintaining, or even increasing, the productivity of agricultural land, as well as improving the natural environment for rural economies at large. Achieving these objectives needs more labour inputs and at the same time is an opportunity to maintain –even increase - employment in those sectors dependent on natural resources. From this perspective, family farms are particularly important as they occupy a much wider range of environments, landscapes and territories (e.g. mountainous areas) than those suitable for large-scale industrialized farming. However, the NRM policy framework and accompanying measures need to allow, and where necessary incentivize or pay them to continue playing their significant and productive role in NRM.

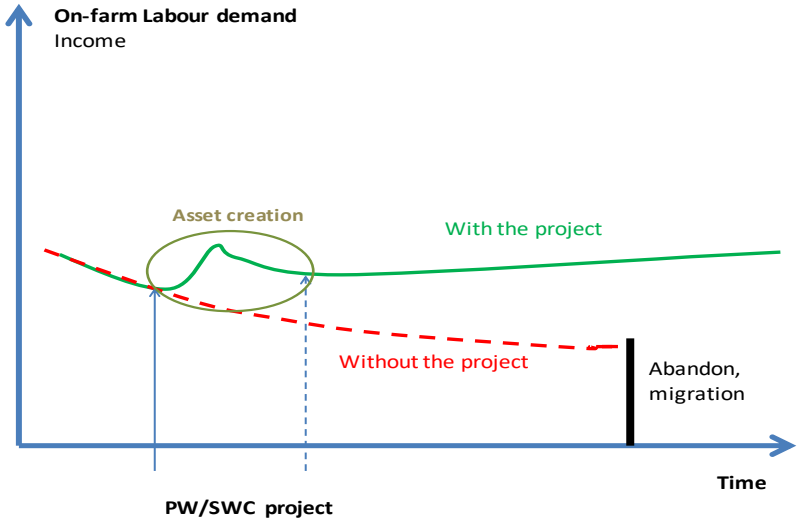
A shift in paradigm is gradually imposing itself, with the emergence of the so-called "Agro-ecology"[17] approach, which aims to apply ecological science to agriculture and

[17] Agroecology's holistic approach -incorporating the traditional knowledge and skills of the world's farming communities with cutting edge ecological, agronomic, economic, and sociological research, has the potential to support strong, democratically-based food systems that provide health and livelihood to small-scale, family farmers, rural communities; as well as environmental benefits. (...), agro ecological initiatives and practices have been recognized as achieving sustainable agriculture and development while reducing rural poverty, hunger and malnutrition and increasing climate

agro-ecosystems, and encompasses a wide-variety of practices[18], which are meant to be coherent with key principles of environment preservation, social fairness, and economic viability. Agro-ecology strives to combine parameters of sound NRM, low external inputs (like minimizing the use of chemicals by using on-farm renewable resources, privileging endogenous solutions to manage pests and diseases and using as much compost and organic fertilization as possible), with an approach that upholds and secures farmers' livelihoods. Because it involves more activities per unit of land than conventional agriculture, it also requires more labour inputs. Agro-ecology is an option that may be able to provide jobs, improved livelihoods, and create resilience against climate change and its related shocks. Not only is it more labour-intensive than conventional agriculture, it also preserves the natural potential better, therefore contributing to the durability of farming jobs.

Likewise, soil and water conservation (SWC) activities are expected to enhance/restore the productive potential of the land, thereby making agriculture more sustainable, with a positive mid to long-term impact on existing livelihoods and jobs. Figure 3 provides a conceptual illustration of how the implementation of SWC activities (through a dedicated project or scheme investing in SWC asset creation) may affect on-farm labour demand.

Figure 3: The expected impact of soil & water investments at farm level



Source: Authors

Reconciling agricultural productivity and conservation through the "Sustainable Crop Production Intensification" (SCPI) approach

In order to meet projected demand over the next 40 years, farmers in the developing world must double food production, a challenge made even more daunting by the combined effects of climate change and growing competition for land, water and energy. To achieve

resilience of agriculture. Agroecology also provides perspectives for rural youths and can help slow the rural exodus currently occurring (in sub-Saharan Africa.) (FAO, 2016).

[18] Biological agriculture, Organic agriculture, Permaculture and Agro forestry… are all variations on the theme of reconciling production and conservation of the NR capital. "Conservation agriculture" is another variant that takes up some aspects of agro-ecology but still requires a significant use of chemicals.

that goal in a sustainable manner, intensification will have to be part of the solution, since the expansion of the agricultural frontier has reached (or overpassed) its limits in most environments. In many areas, further encroachment will have detrimental effects on forests or other ecosystems that are sustaining wild flora or fauna. The FAO (2014) promotes a new paradigm dubbed "sustainable crop production intensification (SCPI)", which aims at producing more from the same area of land while conserving resources, reducing negative impacts on the environment and enhancing the natural capital and the flow of ecosystem services.

Farming systems for SCPI would be based on conservation agriculture practices, and will include agro-forestry practices. It will require the use of good seed of high-yielding adapted varieties, integrated pest management, plant nutrition based on healthy soils, efficient water management, and the integration of crops, pastures, trees and livestock into an agro-forestry approach. Such systems are more labour-intensive and less capital intensive compared to modern industrialized farming. In addition, in the case of small farmers, indications are that where these practices are adopted they also result in increases in productivity as well as better socio-economic outcomes (Hughes et. al. 2020).

They are also more knowledge-intensive, and one would also expect this to effect labour demand as they are adopted more widely. Policies for SCPI should build capacity through extension approaches such as farmer field schools, and facilitate local production of specialized farm tools. Such increases in skill levels and specialization would most likely lead to creating better and more productive agriculture related jobs.

The potential for increasing NRM- related employment within agriculture and associated activities is undoubtedly considerable. While quantifying this overall potential is difficult, this review will present estimations for some related activities further below. Whether this potential will ever be fully realized will depend on how decisive and effective policymakers are in their efforts to make fundamental changes in the way the present largely, unsustainable agricultural systems operate.

2.4 Forestry, NRM and employment

According to FAO estimates, the overall forest sector employs globally some 54.2 million workers, in both formal and informal economy.[19] In addition, an estimated 350 million people, about 70 million of whom are indigenous and tribal peoples largely depend on forests for income and subsistence.[20] In addition, 2.4 billion individuals still rely on wood as their main source of cooking fuel[21]- be it raw or as charcoal - particularly in households in developing countries.

Officially, employment in the forest sector often includes the forestry workforce in production and harvesting of wood (round wood production, reforestation, harvesting, and fuelwood production) and non-wood forest products, and wood-related industries (wood processing, pulp and paper). Non-wood forest products, such as those used as medicine,

[19] FAO: Contribution of the forestry sector to national economies, 1990–2011, op. cit.; FAO: State of the World's Forests 2014: Enhancing the socioeconomic benefits from forests, 2014; FAO: Global Forest Resources Assessment 2015: How are the world's forests changing? Second edition (Rome, 2016).

[20] ILO 2019

[21] With dire consequences on public health : an estimated 1.5 million people a year die from respiratory diseases caused by the smoke from fuelwood in improper cooking devices

food or material for crafts have the potential to generate employment, increase incomes, and improve health.

The forest sector is characterized by, on the one hand, vertically integrated multinationals and, on the other hand, thousands of micro, small and medium-sized forest enterprises, which are often informal and especially significant because they tend to be very labour intensive and can be a growing source of employment, especially in developing countries. The distribution of employment between forestry and related sectors also varies by region and so do the multipliers. For example, there are seven jobs in forest- related processing for every one job in forestry and logging sub-sector in North America, while in developing countries the ratio is roughly one-to-one. This may be due to a much higher degree of mechanization of forest operations - as well as a larger array of wood products derived from them - in North America and industrialized countries in general. It has been estimated that, in 2000, at the global level, approximately one person was employed in forestry for every 1,000 ha of forest, and that this employment was supplemented by another two jobs in processing (wood industry and pulp and paper industry). In many countries forest-related work is not a primary occupation, but complements other activities, such as agriculture. The labour intensity of forestry operations also varies a lot from country to country[22].

One of the greatest challenges related to employment and forestry is deforestation. Agriculture has been identified as being the overriding cause of tropical deforestation (FAO, 2011). Although forests can be quite resilient to small-scale traditional slash-and burn agriculture, this is not the case for permanent intensive agriculture. Changing land use to livestock farming also causes extensive deforestation (especially in tropical forests). Intensive logging, (often illegal) mining, the construction of roads and other infrastructure in forest areas and forest fires are also cited as direct causes of deforestation. In this sense, economic interests and alleged job creation in agriculture and other economic activities, as mentioned above drive deforestation. A critical issue is therefore to be able to demonstrate that forests already support many jobs and livelihoods, and that development and job creation can take place without further deforestation. Ferreira Filho and Poschen (2019) have taken up this challenge, and have found that in the Amazon State in Brazil, the forest supports many more jobs than previously thought- while also showing that the type of agricultural activities driving deforestation are not better in stimulating economic growth than the activities based on deriving sustainable livelihoods from the forest.

Decent work is fundamental to ensuring sustainable and productive forestry operations that are environmentally friendly, safe for those working in them, and benefit the millions of people who depend on them for livelihoods, food and shelter.[23] Decent jobs created in sustainable forest management will help avoid further deforestation. Where forests can be preserved, they will continue to provide direct and indirect job opportunities, including new jobs in the green economy, such as forest maintenance and protection, sustainable forestry and land management.

[22] The numbers employed in forestry activities amount to 25 persons per 1,000 ha in Turkey and only 10 persons per 1,000 ha in China. http:// www.fao.org /docrep/007/ad493e/ad493e06.htm

[23] ILO. 2019. Conclusions on promoting decent work and safety and health in forestry, https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---sector/documents/meetingdocument/wcms_701340.pdf

2.5 Nature conservation, NRM and the jobs economy

The type of work that is perhaps most clearly definable as NRM-related is nature conservation. This includes the management and care for protected areas. The status and degree of protection of such areas varies and the IUCN has defined six categories of protected areas (See Box 4). So far no assessment has been done to estimate the labour force required to manage and protect these areas to the standard required. The difficulty of doing so is compounded not only by the fact that these different protected areas require different levels of labour input, but also that such protected areas are managed at different levels of government (national, provincial/state, local) and institutions (ministries, boards, agencies and NGO). Furthermore, because PAs are often understaffed, underfunded, and face many external threats. Experience has shown that legal protection alone is not enough to ensure effective conservation activity. In reality, many protected areas suffer from encroachment by farming and cropping activities, not to mention poaching. Improved staffing of such PA would be an important part of the response to address these issues.

An interesting analysis on staffing of protected areas was provided by the SEMEIA institute in Brazil (SEMEIA 2014). In comparing the number of employees per ha of protected area in Brazil with other countries, they found that in 2008 there was one employee per 18,600 hectares in Brazil, compared with 1 per 2,125 ha in the U.S., 1 per 5,357 ha in Canada and 1 per 1,176 ha in South Africa[24]. According to the IUCN, total global protected area amounts to 20 million square kilometres, or 2 billion ha and around 15 percent of landmass.[25] Using these figures, some tentative extrapolations can be made as regards what would be required to properly staff all protected areas in the world (Table 1). Increasing the world's protected area - in line with the Aichi Biodiversity Targets - to 17 percent, would of course increase this employment potential even further.

Table 1: Number of employees per ha of protected area and employment potential

Country	Protected ha/ employee	Employment potential for total global protected areas (2000 million ha)
USA	2,125	940,000
Canada	5,375	372,000
South Africa	1,176	1,700,000
Brazil	18,600	107,000

Source: Compiled from figures in SEMEIA 2014

It can be argued that the figures from the USA, Canada and South Africa can be considered more representative of the number of jobs required to manage protected areas. The figures above imply that between 370,000 and 1.7 million direct jobs could be sustained or created though the management and protection of the world's protected areas. And while this is a low figure relative to global employment it is yet far from being fulfilled.

[24] The National Parks Service in the USA has approximately 20,000 staff (www.nps.gov) . In Canada, Parks Canada employed the equivalent of 5,566 full time employees in 2018-19 (www.pc.gc.ca) and in South Africa, in 2016 South African National Parks had 5,432 staff or which 4,027 permanent (SANPARKS 2017).

[25] https://www.iucn.org/news/secretariat/201609/world-now-protects-15-its-land-crucial-biodiversity-zones-left-out

One critical condition for the good management of PAs is not only sufficient staffing, but that it is done with skilled and competent human resources and thus results in decent jobs.

The potential quantum of employment will also depend on local conditions as well as the type of threats to any given PA. For example, in Eastern and Southern Africa, poaching of large animals is a constant threat. This not only requires a sufficient number of rangers to protect wildlife and deter poachers, but also that these rangers are properly trained and equipped. This also implies the need for decent employment conditions that provide sufficient income, protection and equipment to ensure rangers can work in safe and healthy environment and with adequate compensation for their work, as well as to minimize the risks that rangers are demotivated or bribed (Belecky et. A. 2019).

Biodiversity conservation can only generally be ensured by the creation of substantial areas reserved for production around the PAs. Such "buffer zones" can help preserve the protected area by providing local people with benefits, as they are meant to form a physical barrier against human encroachment of the centrally protected area, that also extends the natural habitat of the protected area to beyond its legal boundary. Furthermore, the support of local people in conservation objectives can be promoted by their participation in the harvesting and management of buffer zones (e.g. through establishing forest and agricultural tree plantations, the use of appropriate agro-forestry practices; hunting, controlled NTFP collection, and other activities – see Box 5). However, one drawback of buffer zones is that the economic development they generate can in turn attract additional people and increase the pressure on the resources. Protected areas can never protect all wildlife, and, in some situations, well-managed lands can be more effective vehicles for wildlife conservation than badly managed or under-resourced protected areas. Such alternative may also be better in terms of sustained employment. What is certain is that the management and planning of PAs should involve all stakeholders, in particular the rural populations living in them or surrounding them, who are most affected by their presence and should benefit from the alternative sources of employment and economic activities they potentially provide.

Box 4: IUCN Protected Areas Categories System

The IUCN classify protected areas according to their management objectives. These categories are recognized by international bodies such as the United Nations and by many national governments as the global standard for defining and recording protected areas and as such are increasingly being incorporated into government legislation. They are:

Ia Strict Nature Reserve .Category Ia are strictly protected areas, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values. Such protected areas can serve as indispensable reference areas for scientific research and monitoring

Ib Wilderness Area Category Ib protected areas are usually large unmodified or slightly modified areas, retaining their natural character and influence without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition.

II National Park Category II protected areas are large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible, spiritual, scientific, educational, recreational, and visitor opportunities

III Natural Monument or Feature Category III protected areas are set aside to protect a specific natural monument, which can be a landform, sea mount, submarine cavern, geological feature such as a cave or even a living feature such as an ancient grove. They are generally quite small protected areas and often have high visitor value

IV Habitat/Species Management Area Category IV protected areas aim to protect particular species or habitats and management reflects this priority.

V Protected Landscape/ Seascape A protected area where the interaction of people and nature over time has produced an area of distinct character with significant, ecological, biological, cultural and scenic value:

VI Protected area with sustainable use of natural resources Category VI protected areas conserve ecosystems and habitats together with associated cultural values and traditional natural resource management systems. They are generally large, with most of the area in a natural condition, where a proportion is under sustainable natural resource management and where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area.

Source: https://www.iucn.org/theme/protected-areas/about/protected-area-categories

Finally, it should also be pointed out that the above estimates provide only a very limited overview of the labour demand- and employment related to these protected areas. In addition to the direct employment by institutions responsible for protected areas, there is a legion of NGOs involved in a wide range of related activities such as advocacy, awareness raising, research, fundraising, protecting and supporting specific (threatened) species and rescue of individual animals. Well- known international NGOs such as WWF, Conservation International, along with thousands of national local NGOs provide paid employment but also rely on large amounts of volunteer labour. In terms of the variety of occupations, the website on conservation careers lists 34 job categories related to conservation.[26] The potential for this sector to provide decent paid employment is also affected by an oversupply of labour - many highly qualified people who have to volunteer to work on the field - mostly because there is no funding, not because there is no need for the work.[27] Finally, the PAs staff figures only represent a small fraction of the travel and tourism-related jobs generated by quite a few protected areas, through surrounding accommodation, tour operators, restaurants and complementary leisure activities.

Box 5: Conservancies in Namibia

The Namibian Community-Based Natural Resource Management or CBNRM program spearheads the government's national program for sustainable development. This program is based on granting exclusive rights to the use of natural resources to State-accredited "conservancies".

These conservancies, which take the form of associations, are invested with legal authority and financial autonomy, and operate within clearly defined geographic areas. They have a governing body and an equitable benefits distribution plan. They conduct their activities (trophy hunting, bush meat trading, green tourism and visual tourism) by entering into contracts with specialized local operators.

The contract clearly states the terms and conditions as well as the duties of the parties, which are defined at the national as well as local levels. The services are paid for by the end users (trophy hunters, bush meat consumers or tourists) through the operator, who acts as an intermediary; the amount and terms vary, depending upon the service provided.

All the net income arising from these activities (including tourism activities) after payment to the operator, are handed over to the conservancy, which uses the money to fund community projects and/or redistributes it among community members, as per the utilization principles agreed upon at the time of the application for approval.

[26] See www.conservation-careers.com for a list of these job categories.
[27] https://www.theguardian.com/environment/2017/aug/17/all-work-no-pay-the-plight-of-young-conservationists

Regulatory safety mechanisms set up by State authorities and internal control systems implemented by the conservancies ensure the proper execution of contracts. The contractual system includes cancellation clauses in case of non-compliance by the contracting parties.

Moreover, local communities retain their right to hunt bush-meat for their own consumption: they are also allowed to develop related activities, such as honey production, harvesting of plant fiber and gathering of aromatic and medicinal plants. These activities are also governed by sustainable resource management regulations.

Private and public interests are closely intertwined. In fact, government authorities oversee project-creating activities by accepting or rejecting local applications for setting up conservancies, determining hunting and levy quotas, as well as ensuring the ex-post monitoring of activities and even taking administrative actions against any noncompliant parties.

It is therefore a rather atypical method; state authorities oversee the "PES" mechanism without intervening directly in it, allowing private operators to run it, operating under the terms of a private contract and on a principle similar to that of a public service concession

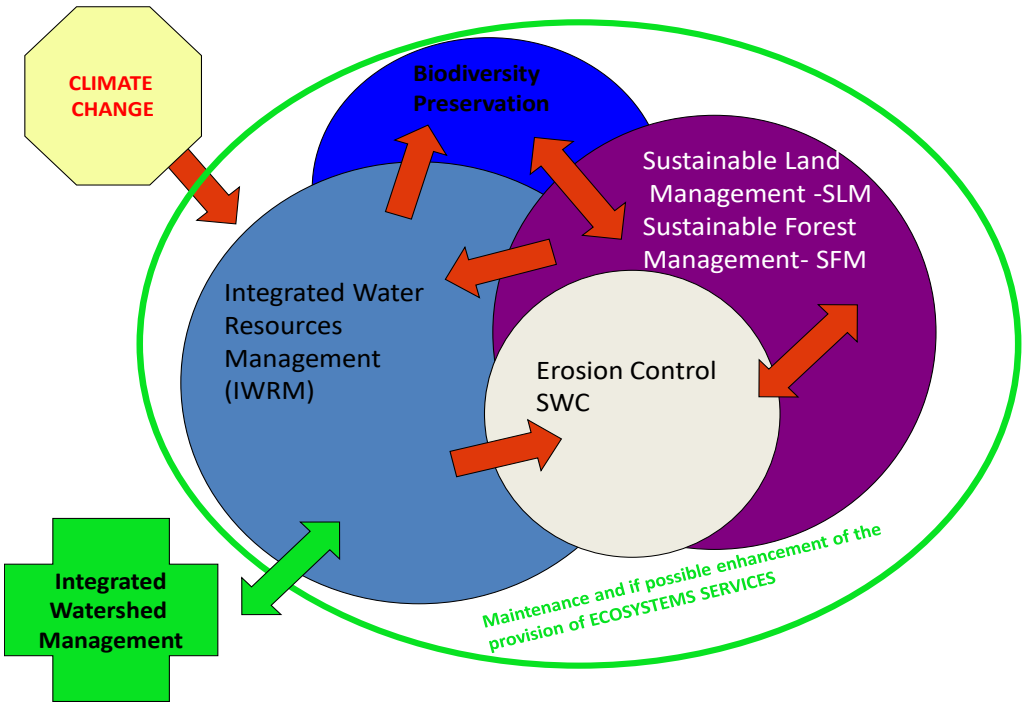
Source: From Lemaneger et. al. 2012

3. Territorial development paradigms: their interaction with NRM and job creation

3.1 Different perspectives on NRM largely overlap

Sustainable Land Management (SLM), Sustainable Forest Management (SFM), Biodiversity conservation, Integrated Water Resources Management (IWRM), Integrated Watershed Management (IWM), are all concepts and acronyms that refer to different approaches aiming at the common objective of sustaining the productive potential of natural resources. Their differences stem from the emphasis they place on one type of resource or another, and from the professional categories/institutions which support them. Actually, the sound managements of land, forest, water, wild fauna and flora are closely intertwined: they are about balancing different resource users' goals and interests – while maintaining the potential for – and delivery of- ecosystems services (Figure 4).

Figure 4: The interaction between different NRM approaches



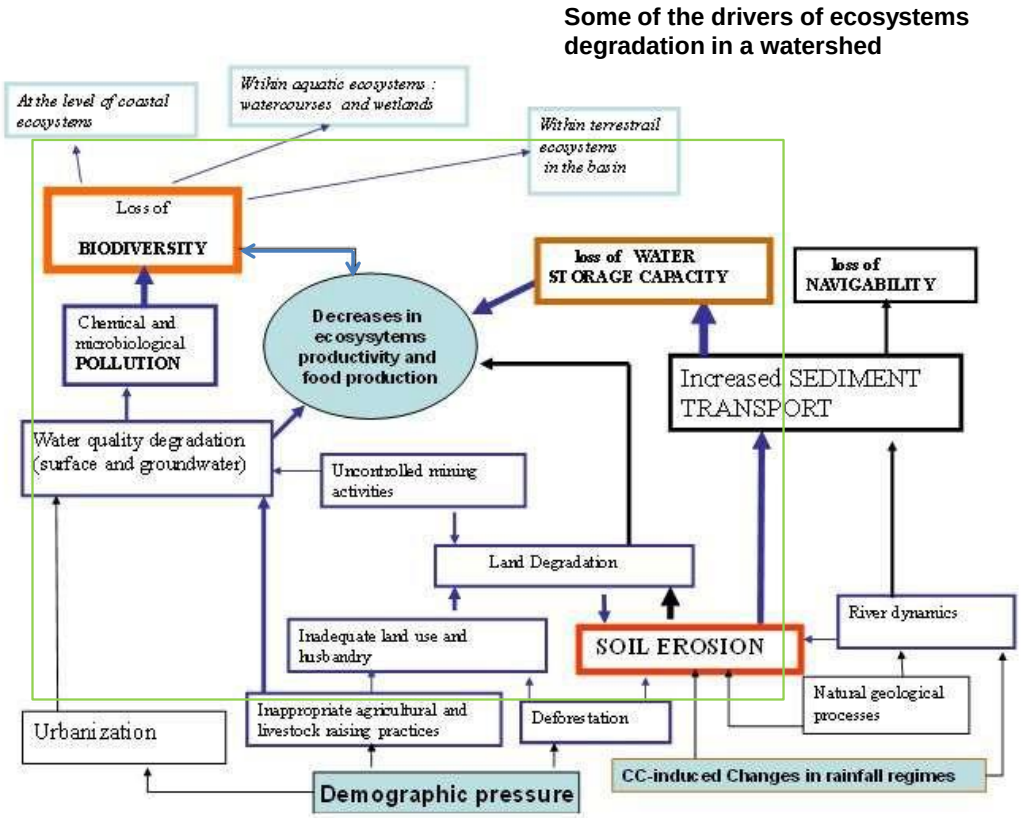
Source: Authors

Often, decisions on how to intervene on NRM in a given territory are made without cross-sectoral coordination, targeting sector-specific optima which turn out to be suboptimal when looking at the whole - and result in risks and uncertainties spread across sectors and scales. For example, a sector or resource-focused intervention can indirectly affect societal structures, the state of other natural resources, or financial flows. In order to ensure the optimal management of trade-offs and the maximization of overall benefits, decision-making processes need to take into account the dynamic nature of complex systems, providing wide consultation of stakeholders as well as feedback mechanisms.

For these reasons, the watershed has been for quite a while considered as the most suitable planning unit given the importance of water, and the linkage it creates between the

needs of upstream and downstream dwellers and their use of their natural resources endowment (Figure 5).

Figure 5: Many drivers of ecosystems degradation can be apprehended at watershed level



Source: authors

3.2 Landscape management: an integrated perspective on NRM.

Because the watershed is however not what farmers and other stakeholders usually have as a mental image of the territory they interact with, an "integrated" approach is now thought to be better applied through the so-called "landscape" –as a unit of planning. Landscapes may be defined as "the concrete and characteristic products of the interaction between human societies and culture with the natural environment" (FAO 2012). Agricultural landscapes for instance can be described in terms of three elements:

(i) structure – the interaction between environmental features, land use patterns and man-made objects;

(ii) functions – the provision of landscape functions for farmers and for society (environmental services) and;

(iii) value – concerning the value the society places on the landscape and the costs of maintaining and enhancing landscape functions.

Landscape or territorial protection is concerned with the characteristics and functions of a landscape, including its associated natural resources and the population's related socio-economic and cultural activities.

Landscape protection therefore must consider the forces and pressures transforming landscapes and the effects that such changes have on the values of the landscapes and the benefits different stakeholders derive from them. A landscape approach factors in human activities and their institutions, viewing them as an integral part of the system rather than as external agents. This recognizes that the root causes of problems may not be site-specific and that a development agenda requires multi-stakeholder interventions to negotiate and implement actions.

The Integrated Landscape Management (ILM) is thus the latest paradigm that aims to be all-encompassing and builds on a spectrum of approaches, including integrated resource management, watershed management, comprehensive regional land-use planning and ecosystem-based management. It is meant to help decision-makers understand the linkages between the environment and humans, and provide opportunities to explore potential future development pathways and policies[28].

ILM aims at generating solutions that: (i) achieve multiple objectives at once, (ii) improve inter-sectoral coordination and cost-effectiveness at multiple levels, (iii) empower communities through multi-stakeholder processes, (iv) enhance transboundary and regional cooperation by considering ecological connectivity, economic cooperation, labor migration, all in one framework.

Decisions on how to use on-farm resources and common property resources in the surrounding landscape depend strongly on the socio-economic situation of the users, their tenure and labour security, their access to services and markets, as well as their education level and financial and organizational capacity. By providing a platform for multi-stakeholder participation and negotiation and shared learning, ILM intends to facilitate dialogue and cooperation. Through adopting this approach, employment objectives - as well as public goods that require labour input to be secured - can thus be better integrated in local development plans.

This however also requires that the institutional arrangements are in place to support such approaches - which is the focus of the next section.

4. Institutional issues impacting NRM and employment in rural areas

4.1 The ownership status of forests and local participation

An important share of the global forest land is characterized by confusion and insecurity over property and/or usufruct rights. There is growing realization that insecure property rights are a key underlying problem and cause of degradation of the world's

[28] Inspired by a Japanese centuries-old form of communal management of forests and arable lands, the *Satoyama*[28] Initiative was established at UNESCO headquarters in Paris in 2009. It is a global effort to realize "societies in harmony with nature" through the recognition and promotion of *Satoyama* landscapes and similar landscapes around the world as a good model for conservation of biodiversity and human well-being.

forests. Property rights to forest lands and resources are often contested, overlapping or simply unenforced. This insecurity undermines sound forest management, for without secure rights forest holders have few incentives - and often lack a legal basis - to make the long-term investments required to sustainably manage and protect their forest resources. While secure rights cannot ensure sustained protection and investments in a forested area, they are often a necessary condition (White and Martin 2002). This is even more so than in the case of smallholders' agricultural lands, because of the much longer-term perspective required for almost every investment in forest management. Indigenous and tribal peoples are in a particularly challenging situation deriving from the unsecure tenure of lands they traditionally occupy, leading to infringements of their customary rights and consequently hindering sustainable forest management. Overall, although there are differences in legislation on forestland tenure and access to forest resources, public ownership is clearly the most preponderant in terms of the global area covered, with an estimated 76 per cent of all forestland being publicly owned (FAO 2018). Moreover, whatever tenure system is in place, the State systematically retains the right of oversight and intervention.

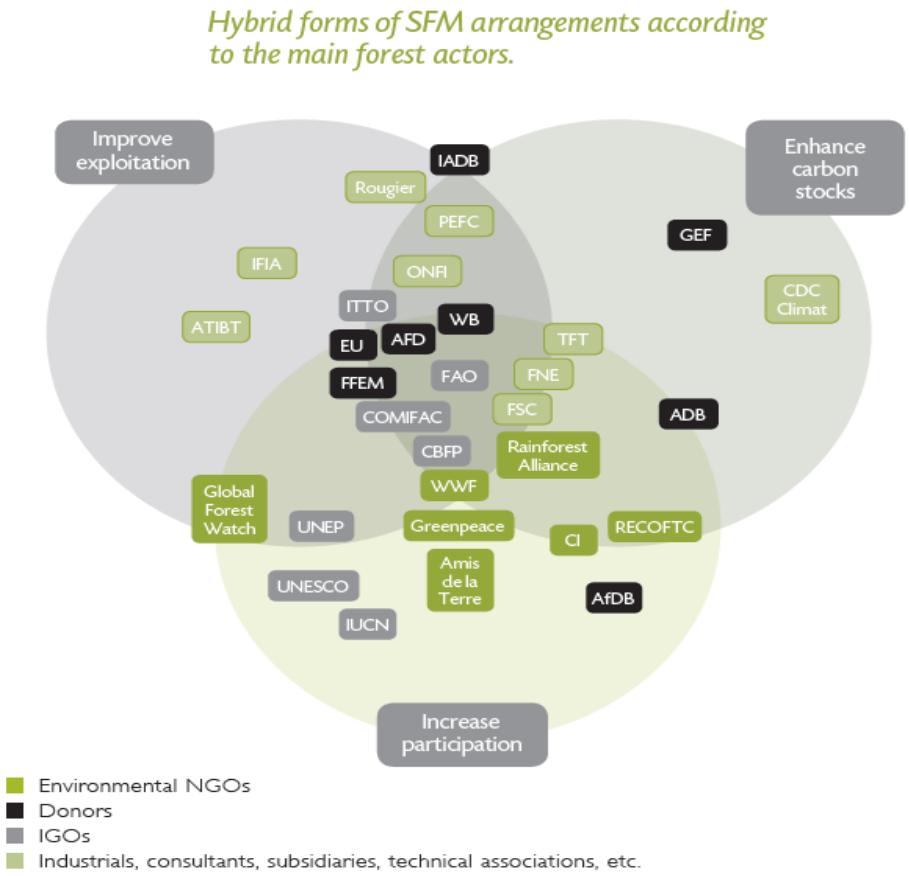
A major trend over the last decades has been to create and institutionalize norms for community-based management of forest ecosystems. Although it took time for the idea to become established, today's discourse seems unanimous and consensual: SFM can only be achieved if local populations, including indigenous and tribal peoples, women and other groups who were not traditionally participate in these processes are involved in its design, implementation and monitoring. Research by the Rights and Resources Institute – RRI[29]- and others has shown that when their rights are secured, indigenous and community forest peoples are remarkably successful at sustaining themselves, while at the same time protecting their forests at least as well as governments or industry.

"Participatory management" is defined by law in many countries and involves transferring rights and management tools from government to local communities, ranging from co-management with the State through to the complete transfer of management tools to the communities. For some countries, "community"-based participatory management is even cited as a prerequisite for the transition to SFM. Often, laws support the participation of local actors by seeking to integrate them into the formulation of forest policies. Despite the achievements made through participatory forest management, and the realization that it may be a necessary condition, it is unlikely to be sufficient to ensure environmentally sustainable forest management.

The main reason for this is that communities may themselves have competing interests and are not the sole actors in forestry management. Figure 6 presents an interesting strategic projection of the different forestry actors' interactions resulting from their respective positioning on economic, social and environmental issues. It clearly shows that the management arrangements are not neutral, that trade-offs may be required and that the choices made are likely to trigger controversy about which solution should be promoted. Increasing "participation" is likely to help integrate employment considerations into the choice criteria for a management model, but this may have adverse effects from an environmental perspective.

[29] www.rightsandresources.org

Figure 6: Hybrid forms of SFM arrangements according to the main forest actors



Source: Lemaneger et. al. 2012

One promising approach is to develop and strengthen forest-agriculture interfaces so they both become more sustainable and mutually beneficial. Forest-agriculture interfaces are characterized by both positive and negative interactions between forests/trees and cropland, livestock, aquaculture or mixed farming systems. These interactions take place at the farm level, in forests, in wider farming systems, and within landscapes. Agro-forestry[30] is increasingly recognized and promoted as an approach that aims to manage these interactions and as much as possible enhance their synergies. It recognizes that forests and trees play a significant role in reducing the negative impacts of extreme events and in supporting food security in all its dimensions: food availability, food accessibility, food system stability. Agro-forestry based approach require a higher degree of labour input and are thus beneficial for creating employment.

[30]Almost half the world's agricultural lands has at least a 10 percent tree cover, suggesting that agro-forestry, an integrated system of trees, crops and/or livestock within a managed farm or agricultural landscape, is widespread and critical to the livelihoods of millions of people (FAO 2013)

Governments usually have the ultimate say with regards to land-use changes in forested areas and their policies in this respect thus have a strong bearing on the extent of adoption of agro-forestry.

4.2 Forest certification

Forest certification is a voluntary mechanism for forest monitoring, tracing and labeling of timber, wood and pulp products as well as non-timber forest products, where the quality of forest management is judged against a series of agreed standards (the so-called Principles, Criteria and Indicators- (PC&I)- to support a sustainable forest management approach). Forest certification can cover more than just logging practices – it can include aspects related to the social and economic well-being of workers and local communities, transparency and inclusiveness in decision making. Unlike national labour laws and regulations, which are enforceable and often based on international labour standards, these initiatives are voluntary and are not legally binding.

Basic requirements of forest certification programmes may include:

- Protection of biodiversity, species at risk and wildlife habitat; sustainable harvest levels; protection of water quality; and prompt regeneration (e.g., replanting and reforestation).
- Third-party certification audits performed by accredited certification bodies.
- Publically available certification audit summaries.
- Multi-stakeholder involvement in a standards development process.
- Complaints and appeals processes.

Currently there is a plethora (over 50) of forest certification schemes. The two most widely adopted certification schemes are the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC). The FSC was created in 1993 at the initiative of large international NGOs (WWF, Friends of the Earth, Greenpeace, Rainforest Alliance, etc.), and offers both forest management and chain of custody certification. The PEFC was created by European companies in 1999 and is quite successful in temperate countries with industrialized forest operations. Extending forest certification can contribute towards sustainable NRM and be a useful tool to preserve forest resources and the jobs they support. It also contributes towards the creation of some employment for those directly and indirectly involved in these schemes, as well as in research and development for how to best manage forests to be able to maintain this certification.

Large majority of certified forests are found in the northern hemisphere, and the impacts of certification are limited in addressing tropical deforestation. In 2015 an estimated 2 per cent of all tropical forests were certified, leaving 98 per cent without a certificate.[31].

4.3 Public works schemes for soil and water conservation and NRM

Public Works Programmes (PWPs) or Public Employment Programmes (PEPs) focusing on conservation and NRM have long been in operation in many countries. The Conservation Corps established during the great depression as part the New Deal in the USA is one of the first programmes explicitly aiming to create jobs through conservation.

[31] "Forest certification" in Global Forest Atlas, https://globalforestatlas.yale.edu/conservation/forest-certification

The ILO has been advocating and supporting such programmes as vehicles for job creation and income security for decades. Their potential has also been highlighted as an instrument to promote green jobs for the poor in response to the global financial crisis of 2008 (Lieuw-Kie-Song, 2009). Influential environmental organizations such as the International Institute for Environment and Development (IIED) are finally "rediscovering" these programmes and their potential for NRM,[32] and advocating that they become part of the various versions of a Green New Deal around the world. These programs provide temporary employment on labour-intensive projects using a local- resource- based approach. Some PEPs are partly or entirely oriented towards NRM and the preservation /enhancement of the natural capital. Such approaches could take on increasing importance for NRM- including ecosystem restoration, nature- based solutions and the climate mitigation role of forests.

They have the potential to become a critical backbone of NRM, in particular where they are well institutionalized and designed with a long-term perspective. Perhaps their most important advantage is that they are able to dissolve the trade-off that has bedeviled conservation for a long time, namely that between the need for sustaining livelihoods and raising incomes on the one side, and the imperatives of nature conservation and NRM on the other side. They are able to do this as their primary focus is on supporting people, through providing them with cash income that supplement their other livelihoods. Thus, they create a direct stake and financial incentive to engage in appropriately protective NRM, as opposed to seeing it as a threat for their NR-based income-generating activities.

At the same time, PEPs can unlock vast pools of underutilized labour to contribute to NRM activities. Flagship programmes like the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) in India, the environmental sector of the Expanded Public Works program (EPWP) in South Africa, and the Ethiopia' s Productive Safety Net Program (PSNP) annually mobilize millions of person-years of labour to work on NRM activities and have all been operating for at least 15 years (See Table 2 and ANNEX 1). They all strive to promote sound NRM approaches, usually based on watershed management principles.

[32] See https://www.iied.org/jobs-nature-green-new-deal-lessons-global-south

Table 2: Public work programme, annual employment, and NRM activities

Programme	Annual Employment	NRM Activities
MGNREGA[i] (India)	55 million households	Water conservation and water harvesting structures to augment and improve groundwater like underground dykes, earthen dams, stop dams, check dams with special focus on recharging ground water including drinking water sources Watershed management works such as contour trenches, terracing, contour bunds, boulder checks, gabion structures and spring shed development resulting in a comprehensive treatment of a watershed; Micro and minor irrigation works and creation, renovation and maintenance of irrigation canals and drains; Renovation of traditional water bodies including desilting of irrigation tanks and other water bodies; (s) Afforestation, tree plantation and horticulture in common and forest lands, road margins, canal bunds, tank foreshores and coastal belts duly providing right to usufruct to the households covered; and Land development works in common land.
EPWP[ii] (Environmental Sector) South Africa	150,000 work opportunities	Removal of invasive plant species, rehabilitation of wetlands, prevention and combatting of wild fires, restoration and cleaning of coastal areas, forest management, land restoration.
PSNP[iii] (Ethiopia)	1.2 million working beneficiaries	Land rehabilitation through enclosure, soil embankment construction, stone embankment construction, seedling production, seedling planting, development of nursery sites, pond construction or rehabilitation, water spring development, hand dug wells, small scale irrigation

Sources: (i) Ministry Of Rural Development, Government Of India, (ii) Department of Environment, Forestry and Fisheries, Government of South Africa, and (iii) Subbarao et al. 2010

4.4 Mainstreaming employment considerations into NRM programmes and activities

A key challenge for enhancing employment in NRM is to enable technical ministries and departments to mainstream employment generation into their activities and responsibilities. These actors predominantly responsible for agriculture, forestry, environment, water, may not always have employment on their radar. Furthermore, many may see direct employment as a cost to be minimized. Their main focus may be on the jobs their sector can sustain (e.g. through the sustainable management of fisheries), but they may overlook the jobs required to ensure this sustainable management.

Similarly, many NRM development projects focus on livelihoods or income generation, but not on jobs or employment. For example, a case study by the WWF on watershed management and forest restoration (Mansourian et. al. 2020) reports the number of people who benefitted from the project direct and indirectly, but is not clear whether these beneficiaries gained from paid work in the process. It would be important for

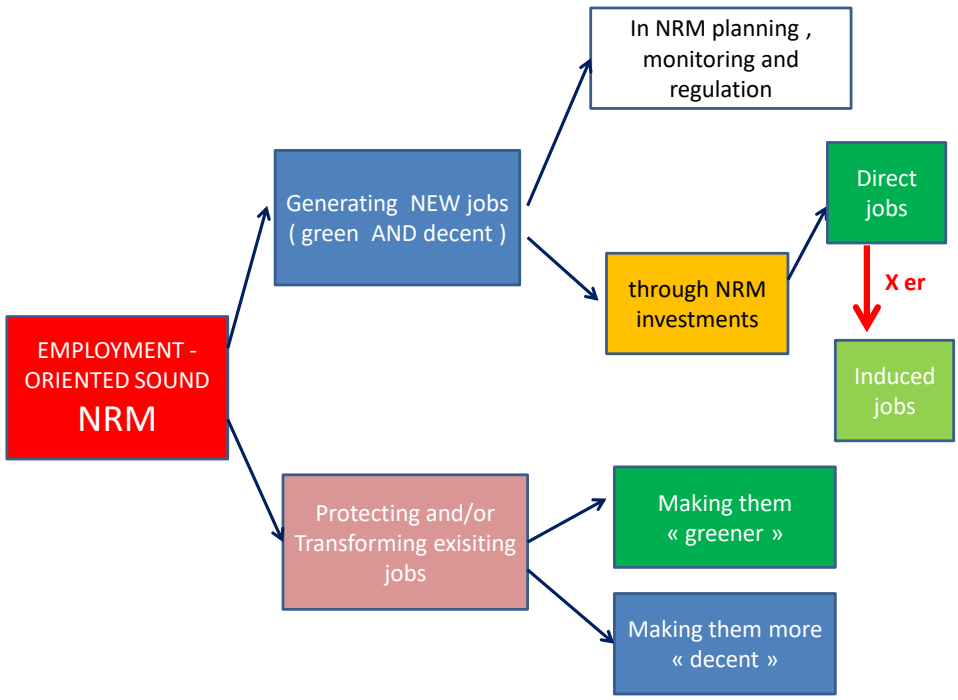
organizations and projects such as these to highlight this aspect because of the different role these benefits play in the livelihood strategies of beneficiaries.

In order to optimize the employment outcomes of a NRM project or investment it is important to integrate an employment criterion into the planning, programming and budgetary work. Figure 7 provides an overview for doing so, considering both the quantitative and qualitative aspects of employment. Putting this into practice requires that the following tasks are carried out [33]:

- To assess, from the incipient design stage, technological options and adopt the most employment-generating approaches whenever this is cost-effective for the society at large;
- To define technical standards and modalities of implementation in different fields ;
- To reflect employment considerations in procurement procedures, implementation arrangements and contract documentation;
- To set up appropriate monitoring mechanisms to optimize the use of locally available labour and resources in the implementation of the activities ;
- To identify potential constraints to meeting employment potential and develop ways and means to overcome such constraints (e.g. through training and skills transfers)

So far, such a comprehensive approach has mostly been used in the context of infrastructure programs, but it can similarly be used to assess the employment impact of NRM-oriented initiatives and investments.

Figure 7 : Employment –oriented sound NRM



Source: Adapted from Ernst et. al. 2015

[33]Adapted from Ernst et. al. 2015

5. Selected types of employment-generating investments in NRM

The range of NRM –related activities below were selected for further investigation in view of their potential to generate employment, and the availability of cumulated experiences from which to learn. The activities are grouped using the SEEA[34] classification of environmental activities.

5.1 Wild flora and fauna conservation[35]

While in certain instances there may have been some economic 'gains' associated with the 'loss of biodiversity', such as growth in the agriculture, fisheries and forestry sectors, on balance, the loss of biodiversity has come at an increasingly massive cost, given the often undervalued benefits that are derived from natural ecosystems.

The Convention on Biological Diversity is the main global mechanism in place that aims to safeguard the planet's web of life. It came into force in 1993 and has three objectives:

1. The conservation of biological diversity
2. The sustainable use of the components of biological diversity
3. The fair and equitable sharing of the benefits arising out of the utilization of genetic resources

There are increasingly urgent calls to enhance the sustainable use of ecosystems, reflecting the acknowledgement of the continuing decline of biodiversity and their long-term economic and social implications. Conservation of biodiversity is pursued for a number of benefits at different scales, not only as a critical source of 'particular biological resources', but also in order to achieve:

- the proper and continued delivery of ecosystem services which are fundamental for the functioning of society ;
- safeguarding resilience of ecosystems and the natural world;
- the provision of options for the future (e.g. rainforests as a source not only of food, water, fibre, tourism, hunting, spiritual healing, climate regulation and other long term/future benefits, but also potential for new sources of medicinal drugs, food options or other functional benefits like natural pesticides)

The combination of the continued and alarming decline of biodiversity, yet increasing recognition of its vital importance, means that investments in safeguarding biodiversity are likely to increase, with implications for labour demand and employment.

5.1.1 Protected areas and biodiversity conservation

The relationship between poverty and protected areas is a complex one, with both positive and negative interactions. On the one hand, protected areas deliver multiple benefits to the people living around them, ranging from tourism to pollination. On the other hand, protected areas may prevent some forms of resource use, and harbour animals that may damage crops in adjacent lands. In particular in tropical zones, numerous problems arise in relation to PAs management. Problems include conflicts with local people over

[34] System of Environmental-Economic Accounting, UN 2014

[35] These activities are classified under Environmental Protection in the SEEA framework

land rights and illegal extraction of animal and plant resources to mention just a few. These problems are often intensified due to the inability of state authorities to protect such areas. Hence, stated conservation achievements do not always reflect reality. In practice, even though there are good examples of effective national parks and forest reserves, the past fifty years or more have witnessed a parallel increase in both the number and surface area of protected areas and a rapidly growing number of extinct or threatened species. By carefully addressing these potential conflicts in an open and inclusive manner, protected area authorities can forge a productive partnership with the rural poor, that may end up in sustained jobs creation.

5.1.2 Fighting against poaching and wild animals trafficking

Poaching in PAs is reaching alarming rates, especially in Africa. Wild animals trafficking is second to drugs as an illegal market. The consequences on tourism and the loss of biodiversity are enormous. There are strong indications that it poses threats to public health as well[36] Law enforcement (and public education) on this issue is a must, and requires far more dedicated human resources than presently employed to address this. The costs may be high but so will be the returns.

A glimpse of employment in this area is provided by a landmark report by WWF, (Belecky, et. al. 2019) which surveyed those working as rangers and are at the frontline of protecting against poaching and wildlife trafficking. The study covered 28 countries, and found that in these countries 102,000 people were employed, with by far the largest share in India where it was estimated that there were 60,000 people employed as rangers. While it is clear from the study that there is a strong need for improving the working conditions of these employees, including salaries and insurance, it was also found that this work is very dangerous, the main threat coming from poachers. Greater number of rangers would thus be a sound policy to reduce the risk for individual workers and improve the protection of these areas, as is can be reasonably assumed that a greater number of rangers would be more effective in both "scaring off" and combating poachers. Given the vast areas that require protection, and that in many countries poachers seem to have the upper hand, increasing the number of rangers would seem necessary. It is hard to provide a global estimate of how many rangers are required globally to properly protect wildlife. But to put the number of people protecting wildlife into perspective, while the 60,000 rangers working in India seems like a high number, an estimated 1.4 million people work as policemen and an additional 7 million in private security in that same country . And in Brazil these numbers are even more lopsided, with 1,600 rangers nation-wide, compared to 687,000 policemen and 1.3 million in private security.[37]

5.1.3 Management of Invasive Alien Species (IAS)

Invasive Alien Species (IAS) have been identified as one of the most important direct drivers of biodiversity loss and ecosystem service changes. Although no reliable global estimates are available, a widely quoted study by Pimental et. al. (2005) estimates the losses and control costs of only invasive crop weeds in the USA alone at USD 27 billion per year. Many international policy instruments, guidelines and technical tools have been developed

[36] Not only "big" animals are poached; it is also the case of smaller ones such as monkeys, pangolins, bats and birds. Globalisation allows their wide circulation, which may be at the origin of epidemics - as suspected for the recent ones.

[37] https://www.forbes.com/sites/niallmccarthy/2017/08/31/private-security-outnumbers-the-police-in-most-countries-worldwide-infographic/#37fe8ddf210f

to address this threat. The Bern Convention[38] is developing a series of voluntary instruments (codes of conduct and guidelines) covering a number of industries, activities or contexts potentially responsible for the introduction of alien species. The aim of these guidelines is to present key principles that should be adopted for PAs, in order to prevent and manage the threat of invasive species at the local, national and supra-national scale.

As the global scale of threat is not well quantified, it is also not possible to estimate the employment potential for its proper management. But it is known that mechanical control[39] in particular is a highly labour-intensive activity. This involves the identification of many species and their manual removal. Furthermore, because the complete extermination of these species is often impossible, their management must be ongoing and the same areas have to be cleared periodically to keep these species at bay. As in most countries the management of IAS is done through community and volunteer work, the labour inputs required -, and its employment potential- is not so well recorded or understood.

South Africa is again an exception, where the Working for Water programme (WfW) has been managing IAS through paid work for the last 25 years. The WfW keeps very detailed track of the productivity rates for the range of tasks involved in IAS management. Based on their experience, labour inputs vary per type of invasive species, biome/ ecosystem invaded, method of removal, the age of the invasive (i.e. a seedling or adult bush or tree) and the level of infestation.

For example for aquatic weeds like water hyacinth, on waterways that are fully infested, using chemical control requires 2 person days per ha, while manual removal requires 12.5 days per ha. Removal of adult sprouting trees in fully infested riparian zones requires up to 37 person days per ha. Marais and Wannenburgh (2008) provide detailed insights on the labour inputs and costs of managing IAS in South Africa under the WfW programme and figures for four of the most common invasive plants in the region: *Acacia, Chromoleana, Eucalyptus* and *Pinus*. For heavily infested zones, total labour input (including follow- up treatments) to control these species ranges from 33.7 days per ha for *Acacia* to 12.4 for *Pinus*. For lightly infested zones the labour inputs per ha is 0.4 to 3.4 person- days. Determining an average based on these ranges is of course difficult, given the many factors involved, but based on the experience with WfW, the controlling of a tree IAS requires on average one FTE to control the spread on 40 ha of infested land. With millions of ha infested across the world, this is another area where substantial employment could be possible.

5.1.4 Restoration and protection of wetlands and water bodies[40]

According to the Ramsar Convention[41] wetlands designate, " areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salty, including areas of marine water the depth of

[38]Article 11.2.b of the Convention of Conservation of European Wildlife and Natural Habitats ("Bern convention", 1979) requires Parties to promote the reintroduction of native species and strictly control the introduction of non-native species.

[39] IAS management is done using natural control (introducing natural enemies of the invasive species), chemical control (using herbicides) and mechanical control (physical removal).

[40] The term "water body" here may cover lakes of all sizes, rivers, streams, coastal bays.

[41]Defined in 1971 , the Ramsar Convention also touches on forests issues in that it gives a special protection status to mangrove forests. It defines the legal basis for the application of mangrove management principles as well as various possibilities for securing financial and technical resources for this management.

which at low tide does not exceed six metres.". They include water bodies but also land mangroves, (peat) swamps and marshes, floodplains and flooded forests, rice-fields, and even some coral reefs[42]**.** They exist in every country and in every climatic zone, from the polar regions to the tropics.

Wetlands cover an area that is 33 percent larger than the USA. Because they have been viewed in a recent past as unproductive or marginal lands, many have been drained and converted. Non-point source pollutants, from sources such as agricultural, forestry, and urban areas, are a leading cause of water quality impairment in wetlands. In many different ways, wetlands are on the "front-line" as development pressures increase: some of them - such as mangroves and tropical peats - are in strong decline and the rate of loss and deterioration of wetlands is accelerating in all regions of the world. There is considerable risk that this will intensify in the coming decades due to increased global demand for land and water, as well as to climate change.

However, wetlands are among the world's most important environmental assets, containing a disproportionately high number of plant and animal species compared to other areas of the world and sustaining a large array of environmental services (fish and seafood nurseries, coastal protection, etc.), food and biodiversity, on which the livelihoods and jobs of many people depend. Freshwater wetlands also act as water-filtration systems and, in the case of peat bogs, store huge quantities of carbon that have been sequestered over millennia .Their conservation is a significant challenge and if successful can have a considerable positive impact on vulnerable populations.

India has launched a special program called RRR (standing for: "repair, renovation and restoration") of water bodies in order to implement rehabilitation works on hundreds of thousands of water bodies in the country, in coordination with MGNREGA (See ANNEX). In Europe, in accordance with the European Water Framework Directive, which requires that water bodies are brought to a "good status", much effort is undergone to assess and improve the "health" of these ecosystems and restore them when necessary. In northern America, too, there is a growing concern about the ecological status of water bodies (including the rising issue of invasive aquatic species such as fish, amphibians, mollusks and algae) and several states in the USA have set up financial incentives for water bodies restoration. It is estimated that from 54 percent (rivers) to 80 percent (coastal shoreline) and even 99 percent (Great lakes) of water bodies in the USA are "threatened or impaired"[43]

Mangrove restoration

Swamps have long had a reputation for being dangerous, smelly and of little value until drained and converted to agriculture or other land uses. Concerns over biodiversity loss and fear of dangerous climate change have, however, led to a reappraisal of their worth. In terms of ecosystem services, wetlands and mangroves have a huge value (Box 6).

In many places, improved land use planning and restoration of these important ecosystems have led to a dramatic resolution of problems associated with their destruction or degradation.

[42] From Wetlands International on www.wetlands.org
[43] Quoted in Pacific Institute, 2013

Box 6: Fast facts on mangroves

- Mangroves are forests of salt-tolerant, mainly arboreal, flowering plants growing in the intertidal zone of tropical and sub-tropical shores. They act as breeding grounds for many commercially valuable fish and shellfish and help to protect low-lying areas from storm-surges and tsunamis.
- Global area is approximately 160,000 km2. Mangrove forests are estimated to have occupied 75 percent of the tropical coasts worldwide, but anthropogenic pressures have reduced the global range of these forests to less than 50 percent of their original total cover. These losses are largely due to over-harvesting for timber and fuel-wood production, reclamation for aquaculture (shrimps) and salt pond construction, mining, oil spills, pollution and damming of rivers that alter water salinity levels.
- Global carbon burial in mangroves is approximately 18.4 MT C/ year
- Rehabilitation/restoration or plantation of mangrove forests is therefore to be encouraged based on ecological or socio- economical considerations, and also because it has the potential of providing a sink for CO_2

Source: Wikipedia and Simard et. al 2018

Inland waters restoration

Drainage, pollution, damming waterways for irrigation and hydroelectric power, straightening water channels, canalizing and the introduction of invasive fish species have all created massive changes in freshwaters throughout the world. The needs for restoration are huge but preventing degradation is likely to have a much higher return on investment than trying to cure.

Peatland restoration

Peat only covers 3 percent of the world's land surface, but it is the planet's largest single carbon store. It has been estimated that 550 billion tons of carbon[44] are stored in peat around the world. Most predictions on climate change are actually based on the potential for boreal and tropical peatlands to break down further, creating a vicious cycle between carbon release and climate change. The preservation, and restoration where feasible, of peat has therefore become an urgent priority. Restoration actions can also have a positive impact on wildlife populations in peat areas, which over the past few decades have frequently been converted - in tropical areas particularly- to other uses, including plantations. Conservation is likely to benefit native flora and wildlife associated with wetland areas.

Projects are taking place in many countries, with varying degrees of success: good examples seem to exist in temperate and cold countries, much less so far in tropical zones.

A striking case is that of the ex-Mega rice project (MRP) in Kalimantan (Indonesia) where vast areas of tropical peat forest have been converted to cropland (primarily for rice cultivation), with disastrous effects. It has resulted in huge losses of peat soils, as well as wild fires and much of the area has in fact been converted to palm plantations, thus creating many times fewer jobs than originally planned with the irrigated rice culture- which proved unsuited to the area – and eventually threatening the livelihoods of indigenous (Dayak) people. Restoring the drained peatlands to something close to their original state has proven to be very labour-intensive and also technically quite difficult and costly. The funding of such endeavours would require a stable source of finance.

[44] This is equivalent of about 12 years of current levels of man-produced green house gasses.

As part of a REDD+ pilot initiative, for the Dayak communities which have been severely impacted by the consequences (peat subsidence, fires, changes in land use) of the massive drainage works undertaken by the MRP, an ILO project[45]successfully tested alternative sources of income (e.g. small-scale fish farming, labour-intensive roads and trails construction and maintenance).

5.2 Enhancing the vegetative cover[46]

Approximately 25 percent of human-induced CO2 emissions are estimated to be absorbed by terrestrial vegetation and soils in about equal quantities. Soil erosion of a well-vegetated area may also be several hundred times less than from a bare soil under the same climatic conditions. The vegetative cover is therefore essential for maintaining the role of land as a carbon-sink as well as combating soil erosion and the associated loss of plant nutrients, thus of carrying capacity . If the vegetative cover is increased using indigenous vegetation, it also plays a critical role in maintaining biodiversity. Enhancing the vegetative cover can be achieved through:

- afforestation (on currently non-forested lands that were forested in the distant past),
- reforestation (of previously forested lands that have been cleared in recent times),
- agro-forestry in lands cultivated for crops and pasture ,
- halting deforestation and degradation of existing forests by protecting or sustainably managing them- including the often neglected maintenance of planted forests

Employment generation through activities such as afforestation, reforestation, improved management of natural forests and their conservation, watershed protection, agro-forestry, urban forestry, etc. – can thus directly contribute to climate change mitigation and adaptation as well as maintaining biodiversity. Carbon sequestration through increasing the vegetative cover remains the only proven large- scale method of man-induced atmospheric CO2 absorption. Providing employment in forest protection and management activities would have the double advantage of:

- slowing down deforestation and degradation that would have taken place in its absence;
- augmenting carbon sequestration through increased tree planting and improved management of forests.

5.2.1 Afforestation / Reforestation

Deforestation and forest degradation are among the main sources of greenhouse gas emissions, and investments on reforestation and afforestation is receiving more and more attention, including from the climate change perspective through the increased recognition and adoption of so-called nature- based solutions (NBS). Research by Bastin et al (2019) has shown that there is a global potential for increasing tree coverage by 900 million

[45] ILO 2013, GLACIER Project Brief, Available on https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---ilo-jakarta/documents/projectdocumentation/wcms_203333.pdf

[46] These activities are grouped under *resource management* within the SEEA framework. Re and Afforestation and fire management can be classified as both environmental protection or resource management in the SEEA framework, the main distinction is whether or not the land is meant to provide habitat for wildlife.

hectares (a 25 percent increase), and that if these restored woodlands and forests were allowed to mature to a similar state to that of existing ecosystems, they could store 205 gigatonnes of carbon. And while the maturing of these trees and forests would take decades, this still represents a very effective measure for absorbing CO2 from the atmosphere. It must be emphasized however that this alone would be far from sufficient to limit global temperature rise to 2° C and should by no means be seen as an alternative to reducing carbon emissions and shifting to a low carbon economy.

Nair and Rutt (2009) estimated the employment potential of different types of investments in forest restoration and conservation. At the time they estimated that 10 to 16 million full-time job equivalent (FTE) could be created based on an annual investment of USD 36 billion (Table 3). This would result in the enhancement or conservation of 52 million ha of land and amounts to approximately 275 FTE per million USD invested. However, they give no indication of the environmental and economical underlying context from which these figures are derived. As a matter of fact, work productivity and costs vary widely across the globe

Table 3: Potential new jobs in sustainable management of forests and level of investment required (annual targets for an initial five-year period)

Activity	New jobs (million, full-time equivalent)	Annual target area (million ha)	Approximate annual outlay (billion US$)	FTE/ USD million	FTE/ ha
Afforestation, reforestation and desertification control	4–5	5	8	500 to 625	0.80 to 1.0
Improvement of productivity of existing planted forests	0.5–1.0	10	1	500 to 1000	0.05 to 0.10
Watershed improvement	1–3	1	6	166 to 500	1 to 3
Indigenous forest management	1–2	4	5	200 to 400	0.25 to 0.50
Forest conservation	2–3	20	7	285 to 428	0.10 to 0.150
Agroforestry	0.5–0.75	2	1	500 to 750	0.25 to 0.375
Fire management	1.0–1.25	10	5	200 to 250	0.1 to 0.125
Urban and peri-urban forestry	0.1–0.5	0.1	2	50 to 250	1 to 5
Skill improvement of forestry and wood industry workers	0.05		1	50	NA
Total	**10.1–16.5**		**36**	**281 to 458**	

Source: Nair and Rutt 2009 elaborated upon by authors

Experience from the ILO on 8 reforestation projects in Rwanda, Burundi and Cape Verde has provided higher productivity estimates (Keddeman,1987). For these projects the average was 0.58 FTE of labour input per reforested ha. The range of productivities also varied: for example the averages per country were 0.42 FTE/ha for Burundi, 0.82 FTE/ha for Rwanda and 1.11 FTE/ha for Cape Verde[47].

Based on these figures, the afforestation of 900 million ha of land would thus generate between 540 and 900 million FTE of employment. If this were to be achieved over –say three - decades, this might imply close to 30 million full time jobs per year. These are of course very high figures, and based on one approach to afforestation. In reality different methods with different labour inputs would be used, based on available budgets and the

[47] There were other important variations per country, including the number of trees planted per ha, availability of skilled labour, species of trees planted, topography, accessibility to the sites, and condition of the sites.

type of land and ecosystem to be afforested. Indeed, on some land where sufficient forest is left, natural regeneration methods can be used, which requires very little labour input. Furthermore, when embarking on afforestation on such a scale there would be enormous incentives to use more efficient mechanized methods of afforestation, in particular in countries with high labour costs and where forests are more homogeneous. Nonetheless, even if only 30 per cent of the 900 million ha would be performed using labour-intensive methods of reforestation, the employment implications would be enormous[48]. Clearly, embarking on the large scale afforestation that mitigating climate change demands requires a detailed assessment of the employment effects. It is also important to examine what type of work may be generated from these activities and how this could be implemented

Currently, the industry standard for forestry is dominated by seasonal, contract work. Tree planting is too-often low-paid, with few to no social benefits and often conducted by migrant workers. Payment is commonly determined by piece wages, which often leads to rushed work and long hours on the job. To create actual "green" jobs may necessitate vigorous requirements to ensure that the work is performed in decent conditions. And when it comes to afforestation, work conditions are even more poorly defined, as it is too often not considered employment, but some version of voluntary or altruistic work. Alternatively, as in the case of China reported below, some kind of conditionality is imposed for receiving social assistance.

However, in practice af- and re-forestation are often much more complicated than simple tree planting operations, in particular if there are people who live in these areas and depend on the land to be afforested for their livelihoods.

The large-scale efforts for reforestation in China in the early 2000s provide an excellent example of these complexities (See ANNEX). As part of this reforestation in the Yangtze and Yellow River watersheds, people who were living in these areas, and in particular those practicing agriculture had to be compensated somehow for having to give up land. This compensation was provided through a social protection mechanism called "conditional transfer", whereby affected people initially received a specific quantity or rice, with the condition for receiving this transfer being that beneficiaries had to work on reforestation activities. The size of the transfer depended on the area of land that was given up to be afforested. After a few years, the rice transfer was changed into a cash payment. Overall, 32 million households have received cash incentives to engage in conservation activities (ILO 2015). The amount of time households had to spend on such activities is unfortunately not clear, but given the number of households involved, it is likely to have been very substantial.

This example highlights a number of key issues. Firstly, that conservation activities are often not seen as "work" or "employment" but some kind of voluntary or peripheral activity. Secondly that the labour input required for NRM is substantial. If these 32 million households in the end provided 30 days of labour input per household per year, this would be the equivalent of roughly 4 million FTE each year[49].

[48] Based on Bastin et. Al, 326 million ha of the land to be restored is in tropical areas where the use of such methods is more likely.

[49] Over the course of the activities cash transfers ranged from USD 161 to USD 483 per ha, depending on the area and afforestation activities required. For these levels of transfers, assuming 30 days of labour input is probably on the low side.

Box 7: Estimating labour inputs at the project level

At the project level, the labour input for afforestation activities is relatively easy to estimate. When planning a new project, it is common to use labour productivity rates such as inputs of workdays per produced output (e.g. number of workdays to excavate a cubic meter of soil, work days per linear meter of trench excavation, workdays per hectare of cleared land or per X trees planted, etc...). Combined with the total quantities of work, it is then possible to calculate the total labour input (which can be expressed in terms of full-time employment equivalent over a year – FTE, often dubbed "(yearly) employment generation"). Finally, the "labour intensity rate" (expressed as: "direct costs of labour / total direct costs ", can be determined when all costs covering labour, equipment, materials and (some) overheads have been established.

The "work norms", or productivity rates, are of course condition-specific and will need to be monitored and refined if projects are started in new conditions [by conditions we refer to amongst others: the site conditions (topography, accessibility,…), the payment modalities, wage rates, type of workers, prevailing climate, type of vegetation etc..] One must be very careful when using productivity rates that have been recorded in conditions that were significantly different from the ones of interest.

The table below is therefore mostly illustrative to provide a sense of how one would approach estimating the employment potential of a project.

Table : Example of calculations of job generation by a 50 ha tree plantation using labour-intensive methods (with density: 800 trees/ha):

Activity	Quantity	Unit	Work "norm" (wd= work day)	Work days "generated"	Remarks
Land preparation (clearing)	50	ha	60 wd/ha	50 ha x 60 wd/ha = 3000	*All these "norms" may significantly vary according to the species to be planted, the land morphology, the workers conditions and skills, the length of a "workday" , etc …*
Seedlings provision	44,000	seedling	5 seedlings /wd	44,000s : 13 s/wd = 3,384	
Digging holes and planting seedlings	40,000	unit	40 plants /wd	40,000 : 40 /wd = 1000	
TOTAL for tree establishment				3,000 + 3,384 + 1000 = 7,384 wd	7,384 wd/ 50 ha = 150 wd / ha; = 0, 65 FTE/ha[50]
Tending the plantation	50	ha	20 wd /ha /yr for 3 years after plantation	3 x 20 wd x 50 = 3,000 wd (= 60 wd/ha)	*Replacing dead seedlings, watering , weeding etc…*
Supervision			10 % of total	Approx. 1000 wd	
GRAND TOTAL	50	ha		Approx. 10,784 wd for 50 ha (= 216 wd/ha)	Approx. 0.9 FTE/ha *A figure which is actually specific to this set of conditions*

Source: Authors

[50] On the basis of 230 wd/yr

5.2.2 Fire management

Increases in forest fires are one of the most visible and dramatic consequences of climate change. Increasing temperatures coupled with reduced moisture have had devastating effects on forests in many regions of the world. The fires in Australia in the 2019-2020 "fire season" were unprecedented in their scale and duration and approximately 18.8 million ha of forest were destroyed[51]. But while these fires in Australia stand out for their scale, the magnitude and loss of life and property of recent forest fires in Brazil, Russia, Sweden, Greece, South Africa and the USA (California) amongst others, have also been largely unprecedented. In many regions of the world, most notoriously Indonesia and Brazil, forest fires have also been associated with the use of fire for land clearing (in most cases carried out for large agro-industrial corporations with the purpose of establishing pastures, soybean or palm plantations).

Measures to prevent, control and fight forest fires will therefore most likely be another area where additional human resources will be required. Fuel management to reduce the incidence and severity of fires could also increase employment, including for local communities. The required activities would depend on the local conditions, but many are labour intensive. The FAO (2006) has issued voluntary guidelines for fire management, which cover the positive and negative social, cultural, environmental and economic impacts of natural and planned fires in forests, woodlands, rangelands, grasslands, agricultural and rural/urban landscapes. The fire management scope includes early warning, prevention, preparedness (at international, national, subnational and community levels), safe and effective initial attack on incidences of fire and landscape restoration following it. Forest firefighting is a high-risk occupation, and as such, it is of particular importance to ensure sufficient safety measures in place for those involved.

How societies respond in organizing fire management will have important impacts on employment. In many countries, the number of people employed as firefighters or more generally in emergency management will have to increase. However, quite a few countries also rely on a volunteer firefighting force and there are millions of volunteer firefighters around the world, in particular in developed countries[52]. There are of course very good reasons for this, most importantly the cost of employing a fully professional force. The extensive reliance on volunteer firefighters in Australia has opened a debate following the 2019-20 fire season, given the scale and duration of the fires. As the fires raged for months, some firefighters in New South Wales had to volunteer for more than 100 days that summer. This raised questions about a "larger, paid, trained, professional emergency management workforce" that would be less reliant on volunteers and could also engage in prevention and preparation activities.[53]. Whether firefighters should be paid, become employees, or be compensated in some other manner, such as through direct payments for lost income, tax offsets for volunteers and their employers, or rent or mortgage assistance, was hotly debated. The federal government did make a payment to these volunteers in 2020 for their extraordinary efforts.

[51] https://en.wikipedia.org/wiki/2019%E2%80%9320_Australian_bushfire_season
[52] https://theconversation.com/value-beyond-money-australias-special-dependence-on-volunteer-firefighters-129881
[53] See for example: https://theconversation.com/australia-can-expect-far-more-fire-catastrophes-a-proper-disaster-plan-is-worth-paying-for-129326 , and https://www.abc.net.au/news/rural/2019-12-27/volunteer-firefighters-approaching-100-days-ask-for-help/11829100

An example of another approach to fire management is the Working on Fire Programme in South Africa. This programme, which falls under the EPWP mentioned earlier and further described in the ANNEX, recruits mostly young people and puts through an extensive training programme after which they are deployed on both fire prevention and fighting duties. The programme is designed to complement and assist existing fire services and can be rapidly deployed when forest fires do break out; it currently employs 5,000 people.

6. Conclusions and Way Forward

6.1 Conclusions

It is clear from the findings in this review that a much-needed global shift towards more conservation and ecosystems restoration will generate substantial additional labour demand and at the same time do a great deal in securing future jobs. Various estimations were presented of the kind of labour inputs that would be required for this. The extent and manner of how this will translate into paid work and employment will however depend on a number of factors, including:

1. How much of this work will be done on a voluntary or paid basis;
2. How much of this work will be done through social protection schemes or other mechanisms that provide income but are not structured as employment;
3. How much of this work will be integrated into economic activities which heavily rely on ecosystems services - such as forestry, agriculture, mining, tourism, water provision and fisheries;
4. The technologies and approaches used for NRM, coupled with the extent to which in some areas, nature may be able to "self-regenerate" with only limited intervention and protection required ;
5. The nature and biomes that will be conserved or restored.

How these factors play out in different countries and contexts will differ vastly, and ultimately employment creation will certainly not be the sole criterion for deciding on the approach to take. However given the urgency of both the need for job creation and ecosystems restoration, it would be beneficial that the corresponding nexus is well understood so that where feasible the synergetic effects of NRM and job creation can be achieved.

Making the economy environmentally sustainable and climate-resilient is no longer a mere option, it has become a necessity that requires very significant shifts away from a "business as usual" scenario. The various benefits arising from the conservation and restoration of ecosystems through proper, sustainable Natural Resources Management could be summarized as:

- Long term conservation of natural resources, be they biodiversity, land, water, etc;
- Optimization of the delivery of ecosystem goods and services; and:
- Opportunities for new job creation, and improved livelihoods, particularly in rural areas.

Indeed, sustainable NRM not only has become a necessity but must also be viewed as holding great potential for jobs creation in the long term, particularly in the maintenance of natural ecosystems and operation/maintenance of productive man-made landscapes (supporting agriculture, wood and NTFP production, animal–raising, eco-tourism...). To unfold this job creation potential will require a strong commitment by both the public and private sectors to address implementation challenges such as the development of conducive and pragmatic policy and regulatory frameworks, institutional capabilities and skilled human resources, as well as funding of technology acquisition, research and development, among other requirements. At present, it is still quite difficult to put numbers on the employment effects of NRM policies and investments. Measures to ensure a greater security of income from ecosystem restoration projects may include some kinds of unusual funding/incentivizing schemes, for instance: a) payment for ecosystem services (PES), or b) earning from the by-products emanating from different conservation and restoration programs that aim at the preservation of land, water, forests, wildlife.

On the basis of the case studies examined in this study, Table 4 proposes the following synthesis:

Table 4: A Synthesis on modalities and prospects for NRM-related employment generation (emphasis on developing countries)

<table>
<tr><th>Investment type

Criterion</th><th colspan="2">Increasing / maintaining forested areas</th><th colspan="2">Small structures and biological practices for Soil and Water Conservation(SWC) in cultivated lands and rangelands</th><th>Wild flora and fauna protection</th><th>Restoration and management of Water bodies ; Shoreline management ;</th></tr>
<tr><td>Financing</td><td colspan="2">REDD
Public/national
Public/ International (donors/MDBs)
Private/national
Private/international (CDM)
PES</td><td colspan="2">Public/national ;

Public/ International (donors/MDBs)</td><td>Public/national ;
Public/ International (donors/MDBs)
INGOs</td><td>Public/national (watershed plans)
Public/ International (donors/MDBs)

Private funds (Tourism industry)
INGOs</td></tr>
<tr><td rowspan="3">Technologies and designs / modalities</td><td>(i) Labour-based Afforestation ;

(ii) Labour-based Reforestation and Assisted Natural Regeneration (ANR) ;</td><td>Special public works schemes ;
OR
Cash for work within Social Safety Nets</td><td rowspan="2">Labour-based construction of SWC Structures (both biological and mechanical)</td><td rowspan="2">Special public works schemes ;
OR
Cash for work within Social Safety Nets</td><td rowspan="2">(i) Monitoring and control of wildlife populations

(ii) Creation and management of protected areas and ecological corridors</td><td rowspan="3">(i) River training - evolving towards restoration of natural flows or artificial restoration (watershed transfers) ;

(ii) De-pollution of lakes; dragging of reservoirs

(iii) Wetlands restoration or creation ;

(iv) Coastal zone management, including mangrove management / restoration</td></tr>
<tr><td>(iii) Restricting deforestation (forest management, fire control, protected areas,..)</td><td>State Service;

Stewardship certification;</td></tr>
<tr><td colspan="2">Check :
- Provide not only for tree stand establishment but also for maintenance ;</td><td colspan="2">Check :
- Seasonality of the works (avoid competition with agricultural calendar)
- Prioritize activities with quick, visible return on investment</td><td>Check :
- Requires high levels of skills development</td></tr>
</table>

Implementation Arrangements	Monitoring / Verifying by specialized entities and/or State Service ; Community contracting;	Force account ; Community contracting; INGOs specialized in conservation;	State Service ; Community contracting ; INGOs specialized in conservation ;	State Service ; Community contracting ; INGOs specialized in conservation ;
Maintenance Arrangements /actors	Forest dwellers; Farmers ; Communities ; Private firms (concessions)[54] ;	Community contracting ;	State Service ; Community contracting ; INGOs specialized in conservation ;	State Service ; Communiy contracting ; Subsidies to owners ;

Source: Compiled by Authors

[54]" e.g. " For profit conservation" (profit comes from the sale of carbon credits) as being experimented in Indonesia

To ensure that these emerging jobs will also be "decent" is an additional challenge. In order to achieve this desired outcome, appropriate signals will have to be sent by the public sector with due consideration of each country's idiosyncrasy and concern to improve the coherence of sectoral policies: though the goal is common and some instruments may be copied from one country/region to another, the pathways are many. In addition to an enabling framework of procedures, regulations, fiscal policies and price signals, the importance of the public sector leading this process is critical. This leadership includes playing an exemplary role through the proper staffing of NRM departments and agencies, mainstreaming NRM into public sector procurement and facilitating the greening of the economy.

6.2 Way forward

It is clear from this review that while there is an enormous need for improving our approaches to NRM- and that this could generate substantial employment -, many uncertainties remain about how they will evolve. To point to a way ahead, we wish to leave readers with a few key questions, to which we have only partial answers, and that follow-up work should explore further.

- **What areas of NRM are the most critical, and most likely to attract attention and investment soon?**

This review has considered a number of areas of NRM. Five of them are suggested as the most critical and are believed to be most likely to attract investment, namely: protection of biodiversity, restoration of water bodies, soil and water conservation, afforestation and forest protection, and coastal management. Their priority ranking will of course differ by country or region.

A number of countries are already addressing their employment creation challenges through ambitious programs to preserve – if possible enhance- their natural resources endowment, pursuing at the same time environmental and social objectives contributing to sustainable development. It is important that these initiatives continue to be supported, and where necessary improved and expanded. Consideration should also be given to establishing similar initiatives in other countries facing such combinations of social, environmental and employment issues.

- **What NRM activities have the greatest job potential?**

Table 5 suggests that large-scale SWC activities are likely to have the greatest potential in LDCs, not only in terms of providing job opportunities now, but maybe even more so by helping maintain existing NR-dependent activities and related jobs. Although the situation may greatly vary among countries, almost everywhere the needs are immense. This is followed by af- and reforestation, which in some contexts can also be very labour-intensive.

Table 5: Estimates of Job creation potential with priority interventions in NRM (This table primarily holds for developing countries)

NRM objective	Importance	Employment creation potential		Examples of interventions
		Short-term	Long-term	
Protection of biodiversity (fauna and flora)	Very high	Medium	Medium	Mnagement of created PAs ; IAS containment Promotion of agro-ecology
Soil and Water conservation	High	High	Very High	Large-scale Public Works schemes Incentives for farmers Promotion of agro-ecology
Coastal zones management	High	Low	Medium	Shorelines protection Mangrove replantation
Water bodies protection / rehabilitation	Very high	Low	Low	Dragging of reservoirs Watershed management to prevent erosion and pollution
Afforestation/reforestation/ Forest degradation avoidance	Very high	Medium	Medium	PES schemes / Ecosystem Restoration - Cash for work as part of Social safety nets

Source: Authors

- **What are the key knowledge gaps for estimating employment effects of NRM investments? How can we fill them? What can we do in the meantime?**

Knowledge gaps were identified at two levels. The first is more technical and relates to the technologies, unit costs, productivities and labour inputs required for different types of NRM interventions, in particular how they vary per region and biome. This knowledge gap exists both at the micro and macro level.

At the micro level, further research is needed. For unit costs and labour inputs, documenting productivities and costs on existing projects - or doing experiments and work-studies, are the only possible source as the desired data are highly context-specific. Data

obtained from large-scale long-standing schemes can however serve in first approximations for planning purposes.

At the macro level further research on how NRM is integrated and/or supports employment in other sectors of the economy is required. The introduction of SEEA has great potential in this respect. Its widespread adoption and implementation would considerably strengthen the possibility of quantifying the importance of NRM for employment, in particular through the Environmental Activity Account.

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Annexes

A.1 Examples of specific financial initiatives designed to promote NRM investments

A.1.1 Nation-wide PES for forest conservation: Ecuador's Socio Bosque

At present, Ecuador has a forest cover of approximately 10 million hectares, of which 40 percent belongs to the national system of protected areas (SNAP), while the remaining 60 percent is in the hands of individual owners, communes, and indigenous communities. In a study conducted in 2006, the economic value of the environmental services generated by the forests in the SNAP alone was estimated as US$45 billion a year, which was the equivalent of Ecuador's entire GDP in that year. The country has had – and still has - a very high level of deforestation. This signifies a large loss of environmental services and of the means of subsistence for thousands of people who live off the forest, to say nothing of the rise in CO_2 emissions.

Inspired by Costa Rica's PES scheme FONAFIFO, *Socio Bosque* (SBP) is an initiative launched by the Ecuadorian government in 2008, which consists of a transfer payment to farmers and indigenous communities who voluntarily commit to the conservation and protection of their native plant cover. The programme has the following objectives:

1. To conserve native forests[55] and other native ecosystems[56] in order to protect their enormous ecological, economic, cultural, and spiritual value. The initial goal was to conserve 4 million hectares of forest and other ecosystems in the first seven years.
2. To significantly reduce deforestation and the emissions of greenhouse gasses it causes.
3. To improve the living conditions of farmers, indigenous communities, and other rural populations. It is expected that between 500,000 and 1 million people will benefit.

Landowners receive $60 for every hectare protected between one and 20 hectares and $30 between 20 and 50 hectares. For each additional higher hectare category, landowners receive less money per hectare for maintaining forest cover, ensuring that smallholders benefit the most. Payment of the incentive is conditional on the protection and conservation of the forests, which means that people are paid the incentive once the conditions established in the agreement they sign with the Ministry of the Environment (MAE by its Spanish acronym) have been complied with.

Participation in the SBP is voluntary. Participants must be identified as belonging to at least one of the following legal categories: natural persons, legally constituted communes, indigenous nationalities, cooperatives and associations. Interested parties are required to present certain documents for registration, the most important being the property title. After an analysis of the priority of the area and a field verification, it is determined whether the lands are eligible to join Socio Bosque and if so, an agreement is signed in which the owner of the land undertakes to conserve the agreed area for 20 years.

[55] Native forest (ref .Socio Bosque Operation Manual) is defined as all plant formations composed of native species that result from a natural process of ecological selection. The formation must also provide at least three of the following environmental services: biodiversity refuge, water regulation, carbon sink.

[56] Refers to other native formations such as scrubland, páramos (short grassy vegetation in high altitude, which is crucial for the regulation of freshwater flows.)

Socio Bosque has invested $61 million since 2008 to conserve forests throughout the country, protecting over 1.5 million hectares of its 4-million-hectare goal by 2016 through 2,800 20-year agreements with private landowners and communities. It has had a marked impact on annual net deforestation in Ecuador, which has declined from 77,000 to 44,000 hectares.

To date, conservation agreements have been signed for over 1 million hectares. The program gives priority to areas with a rapid dynamic of land use change, areas that are critical for the maintenance of ecosystem processes that generate benefits for society and areas with a high incidence of poverty. As well, the MAE has recognized the need to align this initiative within the proposed framework for a future REDD strategy at the national level.

One of the aims of the SBP is that it should have direct and verifiable benefits for poverty alleviation and local development. A specific instrument was designed to guide and follow this process, called social investment plans. Each SBP applicant is required to complete a form outlining how the applicant(s) are planning to use the monetary incentive. The applicants have the flexibility to use the incentive according to their needs and preferences but are guided among different categories of investment
Unfortunately, there appears to be no publicly available evaluation of the social impacts of the program, in particular in terms of job opportunities provided by the transfers and the conservation requirements (forest maintenance, monitoring).

The program is financed by government funds and has also obtained financial support from the German KfW banking group; negotiations are under way with institutional and private donors to obtain more support. INGOs such as Conservation International (CI) through its Conservation Stewards Program have been supporting the program, as well as WWF.

A.1.2 Regional small grants facility: Mangroves for the Future (MFF)

Mangroves for the Future (MFF) is a unique partner-led initiative to promote investment in coastal ecosystem conservation for sustainable development. Co-chaired by IUCN and UNDP, MFF provides a platform for collaboration among the many different agencies, sectors and countries which are addressing challenges to coastal ecosystem and livelihood issues. MFF builds on a history of coastal management interventions before and after the 2004 Indian Ocean tsunami. It initially focused on the countries that were worst affected by the tsunami -- India, Indonesia, Maldives, Seychelles, Sri Lanka and Thailand. More recently it has expanded to include Bangladesh, Cambodia, Myanmar, Pakistan and Viet Nam.

The MFF grants facility offers small, medium and large grants to support initiatives that provide practical, hands-on demonstrations of effective coastal management in action. Each country manages its own MFF programme through a National Coordinating Body which includes representation from government, NGOs and the private sector. The emphasis is on generating knowledge, empowering local communities and advocating for policy solutions that will support best practice in integrated coastal management, in particular the benefits that can be achieved with healthy mangrove forests and other types of coastal vegetation.

A.2 NRM-focused Public Works and Public Employment Programmes

Public Employment Programmes (PEP) are publicly-financed programmes which share the primary objective of creating state-sponsored employment for working age poor who are unable to support themselves due to the inadequacy of market-based employment opportunities. PEPs enable governments to respond to political, economic or environmental shocks. They can vary from temporary employment programmes to more permanent employment guarantee schemes and contribute to social protection through enhancing income security. PEPs usually produce assets or services in multiple sectors that create public value and contribute to the public goods, but the employment is often outside the normal public service. In some countries or contexts they are also referred to as Public Works Programmes, although these often tend to have a stronger focus on infrastructure development.

A.2.1 India's Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA)

Maharashtra was the first Indian state to enact an employment guarantee act in the 1970s. After decades of experimentation , the federal government launched The National Rural Employment Guarantee Act 2005, later renamed as the "Mahatma Gandhi National Rural Employment Guarantee Act" (MGNREGA). It is an Indian labour law and social security measure that aims to guarantee the 'right to work' and to ensure livelihood security in rural areas by providing at least 100 days of wage employment in a financial year to every household whose adult members volunteer to do unskilled manual work. Employment is to be provided within 5 km of an applicant's residence, and minimum wages apply. If work is not provided within 15 days of applying, applicants are entitled to an unemployment allowance. A major aim of MGNREGA is also to create durable productive assets, and the law lists permissible works with a preference for labour-intensive activities : water conservation and water harvesting; drought proofing including afforestation; irrigation works; restoration of traditional water bodies; land development; soil conservation works, flood control; rural connectivity. The law provides many safeguards to promote its effective management and implementation.

The registration process involves an application to the Gram Panchayat and issue of job cards. The work entitlement of '100 days per household per year' may be shared between different adult members of the same household. MGNREGA covered all the districts of India from 1 April 2008.

The Act sets a minimum limit to the wage-material ratio as 60:40. The provision of accredited engineers, worksite facilities and a weekly report on worksites is also mandated by the Act. The most detailed part of the Act deals with transparency and accountability that lays out the role of the state, the public vigilance and, above all, the social audits. For evaluation of outcomes, the law also requires the maintenance of records, like registers related to employment, job cards, assets, muster rolls and complaints, by the implementing agencies at the village, block and state level.

The legislation specifies the role of the state in ensuring transparency and accountability through upholding the right to information and disclosing information proactively, preparation of annual reports for Parliament and for state legislatures, undertaking mandatory financial audit by each district along with physical audit, taking action on audit reports, developing a Citizen's Charter, establishing vigilance and monitoring committees, and developing a grievance redressal system.

Another important aspect of MGNREGA is the potential for women's empowerment by providing them opportunities for paid work. There are three important provisions for

women: one third of all employment is reserved for them (as a matter of fact, they benefit from 52percent of the days worked, according to records), equal wages to men and women, and a provision for child care facilities at the worksite.

All these activities can be carried out on public land, but works such as irrigation, horticulture and land development, can also be undertaken on private land belonging to the Scheduled Castes (SCs) and the Scheduled Tribes (STs) or to families below poverty line (BPL) .

Seventy per cent (70percent) of the jobs take place in the lean agricultural season.

In its World Development Report 2014, the World Bank qualified MGNREGA a "stellar example of rural development". “MGNREGA’s Sameeksha” - an anthology of research carried out in the period 2006-2012 - stated the quantitative achievements of the program as follows:

1. From its inception in 2006 till 2012, around Rs. 110,000 crore (about USD$25 billion) has gone directly as wage payment to rural households and 12 billion person-days of employment (48 million person-years) have been generated. On average, 45 million households have been provided temporary employment every year since 2008. The average number of workdays provided per household is currently at 40 days/year

2. Eighty per cent of households are being paid directly through bank/post office accounts, and 100 million new bank/post office accounts have been opened.

3. The average wage per person-day has gone up by 81 per cent since the Scheme’s inception, with state-level variations. The notified daily wage varies from a minimum of Rs122 (USD$2.5) in Bihar, Jharkhand to Rs.191 (USD$4) in Haryana.

4. Scheduled Castes (SCs) and Scheduled Tribes (STs) have accounted for 51 per cent of the total person-days generated and women for 47 per cent, well above the mandatory 33 per cent required by the Act.

5. 120 million Job Cards have been issued. These along with 90 million muster rolls have been uploaded on the Management System (MIS), available for public scrutiny. Since 2010–11, all details with regard to the expenditure of the MGNREGA are available on the MIS in the public domain

6. As regards the quality of built assets, results are clearly mixed. There are only a few studies that have conducted rigorous scientific analysis on the actual productive performance of these assets. Furthermore, the quality and durability of the assets vary vastly with district/region and cannot easily be generalized at the national level . Different studies found for instance:

-a), in Rajasthan and Madhya Pradesh, works like wells, check dams and stone bunds had been built with good-quality material and the right kind of technical inputs. Over 600 inspected structures could be sustained over a period of 10–15 years and through physical verification did appear sound enough to last that long. However, the same study indicated that the durability of civil works on all weather roads was low, due to non-use of machines like road rollers which are necessary for compaction.

-b) In Jharkhand, the average life of planted trees was found to be only two to three years (as opposed to 15 and above years of projected productive life depending on the type of tree), due to the lack of planning in selection of the location for these works as well as poor maintenance.

- c) A major weakness of water-related works under MGNREGA has been found to be the excessive concentration on excavation and desilting of ponds without corresponding work on treating their catchment areas - or on the construction of dams without sound earth engineering.

A large number of works (40percent at the time of issuance of the Sameeksha), particularly those related to water conservation, remain incomplete. Lack of technical support to communities as to when and where to start a work, as well as delays in payment, have been key explaining factors. Available literature also points out that the extent and kind of impact MGNREGA works have on the environment depend on the scale of the activities undertaken, their technical design, the quality of assets created, and ownership and use of the physical structures constructed. There are only a few studies on the subject that have actually attempted to quantify this impact.

However, the true potential of MGNREGA as a Green Scheme can only be fully realized if additional parameters are included in the planning and implementation, so as to focus on activities specifically from the point of view of environment sustainability and decent work.

The impact of MGNREGA on rural labour markets is far from straightforward. Overall, there is no conclusive evidence to support the claim that MGNREGA might have led to a shortage of labour in the agriculture sector. The effect of setting of a "reservation wage" for rural labourers has been considered to be a significant positive impact of the scheme, as it has allowed them to choose to take up work under MGNREGA rather than be forced to accept work at below minimum wages.

A.2.2 Ethiopia's Productive Safety Net Program -PSNP

Land degradation seriously affects livelihoods and food security of millions of vulnerable people in Ethiopia and threatens the livelihood of many more. The main land degradation arises from (1) high soil erosion rates as a result of steep slopes, continuous encroachment and cultivation of marginal lands; (2) a long history of deforestation, overgrazing, negative coping strategies such as the burning of animal dung, extensive use of charcoal, reduced rotation periods, and others .

Since 2003, the Government of Ethiopia (GoE) has been implementing the Productive Safety Net Programme (PSNP) aimed at improving food security in a more comprehensive and integrated manner. The programme not only provides paid work or transfers to food insecure households, but also addresses land degradation, thus addressing one of the causes of food insecurity among the poor. In 2009, PSNP was reviewed and complementary components were introduced: the Household Asset Building Programme (HABP), Complementary Community Investments (CCI) and Resettlement. Together, these components are designed to move households into food security.

PSNP has two components: the labour-intensive public works component engages in watershed management as well as the construction of community infrastructure. Cash is paid for up to five days of work a month per household member for six months a year. The second component of the program is Direct Support, which provides grants to households who are labor-poor and cannot undertake public works.

There are specific provisions for the inclusion of female-headed households (FHHs) in public works activities, given their higher concentration among the poorest, and recognition that FHHs need more flexibility in terms of working times so that they can accommodate their domestic work and care responsibilities. Public works labor can be used to cultivate the private land holdings of FHHs. Women's involvement in community decision-making

structures is also encouraged. Women represent between 25-53 percent of the direct beneficiaries in each participating region and evaluations have confirmed that the PSNP has helped to meet women's practical gender needs..

The wages rates are reviewed annually and adjustments are made based on market food prices changes. Food currently still accounts for over 40 percent of total PSNP resources. Program research has indicated that this amount can represent the equivalent of approximately 10-40 percent of annual basic food needs, defined in terms of Ethiopia's national poverty line (World Bank, 2010).

Since land degradation is so widespread in the country, Soil and Water conservation (SWC) works account for 80 percent of the works undertaken (and a similar percentage of working days) under PSNP II. After decades of trials and errors and learning from other countries' experiences (e.g. China), the Ethiopian government opted for a policy of "Participatory Watershed Development " for the planning and implementation of SWC activities. Participatory watershed planning is considered as an instrument to "bring rural households back to business" in food-insecure and degraded contexts and "keep rural households in business" in other areas. Besides, watershed development is meant to also enable new job opportunities to emerge, linked to water development, diversified crops, access to markets, reclaimed land, fertility improvement, off-farm activities, and others.

PSNP's impact evaluations have shown that Public works activities to strengthen environmental management and climate resilience such as soil and water conservation can contribute both to improved livelihoods and increased community safety – achieving a dual return on the same investment. Investment in ensuring the quality and sustainability of these public works is a more efficient and effective use of public funds than temporary works or works not built to last. However, none of the evaluations found so far did really investigate the job creation and asset building aspects and rather focused on the important social protection effects.

A.2.3 The Expanded Public Works Programme (EPWP) of South Africa

Given the persistently high unemployment situation in South Africa[57] , the Government launched as early as 2004 a nation-wide initiative called Expanded Public Works Programme, with the objective to provide essential services and infrastructure to disadvantaged communities, develop skills among the unemployed and create much needed employment through the application of labour-intensive work methods.

EPWP spans four sectors: infrastructure, environment and culture (E&C), social and non-state - of which environment-related works is the second largest, with a total annual expenditure of roughly two billion Rands (over 200 millions USD). The E&C Sector of the EPWP is rather unique as a large part of its programme focuses on environmental works relating to sustainable management of land and water resources as well as waste management. The E&C subprogram included stringent requirements of employment generation from the start when many of its activities were designed, thus achieving considerably higher labour intensity[58] rates.

[57] At 29 percent in 2019, or close to 5 million unemployed people, the majority of them for over a year

[58] The degree to which a project applies labour-intensive work methods is commonly measured by the portion of the total expenditure used for the payment of wages. This ratio is clearly only a proxy as it is largely influenced by the selected daily wage (relative costs of labour and of other inputs) and work conditions (payment modalities, work duration, natural conditions, etc.).

Roughly two thirds of the expenditure take place in projects implemented by national agencies, which are in charge of the oldest programmes (see further), namely: "Working for Water", "Working on Fire", "Working for the Coast", "Working on Wetlands". Municipalities and provinces are in charge of a growing share of the projects.

The cost of creating a full (equivalent) of a work year of employment (FTE) is fairly consistent in the various focus programmes of the E&C Sector, generally in the range between R 30,000 to R 60,000 (4,000 to 7,000 USD), with a minimum daily wage rate at R.92 in 2018 (9 USD) and a labour intensity ranging from 25 to 60 percent (the average annual employment duration is 3.8 months).

The E&C Sector focuses on building and protecting South Africa's natural resources and cultural heritage, and in doing so, dynamically uses this preservation work to create both medium and long-term work and social benefits. It has set the following objectives:

a. To link people in the marginalized ("second") economy with opportunities and resources to enable their participation in the developed ("first") economy;
b. To integrate sustainable rural development and urban renewal;
c. To create land-based livelihoods and management;
d. To sustainably develop natural resources and cultural heritage;
e. To rehabilitate degraded natural resources and protect biodiversity;
f. To promote environment-responsible tourism.
g. To develop training frameworks, draft guidelines and design incentives.

The Sector includes a wide variety of programmes and projects, which are organized in a series of focus programmes. Its main areas of operation - as far as NRM are concerned- are:

✓ Coastal management ("Working for the Coast")
This cluster of (sub)programmes provides work and training for unemployed people in coastal communities to create and maintain a cleaner and safer coastal environment. The projects contribute to the goals and objectives of government's coastal policy, promoting the sustainable use of marine resources including a sustainable fishing and aquaculture industry.

✓ Promoting and developing tourism and creative industries. Work in tourism focus on:
-Tourism infrastructure development;
-The development of tourist products;
-Skills development and capacity building, with youth involvement in tourism industries;
-Supporting grassroots enterprises and practitioners in the cultural and creative industries.

✓ Waste management ("Working for Waste")
This programme contributes towards addressing the key problem of poor service delivery in the area of waste management, particularly in urban settings .

✓ Parks and beautification. This area mainly involves:

a. Cleaning, clearing and the beautification of public open spaces such as streets, parks, nature reserves and cemeteries;
b. Supporting communities in improving their local surroundings;
c. Developing infrastructure within protected areas;
d. Greening of parks.

✓ Creating sustainable land based livelihoods, developing and rehabilitating natural resources and protecting biodiversity. This cluster of activities is implemented through subprograms

called “Working for Land “, “Working for Water” ,“Working for Fire” and “Working for Wetlands”, including :

1. Clearing invasive alien plants, re-vegetation of landscapes, improving the productive potential of land, advocating and assisting communities, landowners and farmers with the implementation of appropriate agricultural and land-management strategies;
2. The effective and efficient use of the country's natural resources (particularly land and water resources). Contributing to climate change mitigation through greening, planting indigenous trees and transforming targeted areas into vibrant, green and sustainable settlements;
3. Improving the functioning of the ecosystems ; and promoting biodiversity;
4. Empowering communities affected by fire, in order for them to understand the benefits of, and potential harm caused by fire;
5. The rehabilitation of wetlands and nature conservation.

Table 1/A1 : EPWP sector programs by focus area and sphere of implementation

ENVIRONMENT AND CULTURE SECTOR PROGRAMMES				
Focus Area	**Sector Programmes**	**Municipal**	**Provincial**	**National**
Sustainable Land-based Livelihoods	Comprehensive Agricultural Support and Landcare		√	√ (DEA,DoA)
	Working for Water		√	√ (DEA,DoA)
	Working on Fire		√	√ (DEA)
	Working for Wetlands			√ (DEA)
	Other (Greening and Gardening, Fresh Water Farming, etc)	√	√	√ (DPW, DEA)
Coastal Management	Working for the Coast			√ (DEA)
	Working for Fisheries			√ (DAFF)
	Working for the Forest			√ (DEA, DAFF)
Tourism and Creative Industries	Working for Tourism	√		√ (DEA,NDT)
	Creative Industries	√	√	√ (DAC)
Waste Management	Working on Waste	√	√	√ (DEA)
	Urban Renewal Cleaning of Public Open Spaces	√	√	
	Food for Waste	√		
Parks and Beautification	People and parks	√	√	√ (DEA,DAC,NDT)
	Community parks	√		
Sustainable Energy	Working for Energy			√ (DoE)

Major NRM-related subprograms of the E&C sector are therefore:

- “**Working for water**”; the government’s main programme for fighting the spread of alien invasive plants. Since its inception in 1995, the programme has cleared more than one million hectares of invasive alien plants providing jobs and training to approximately 20 000 people from among the most marginalized sectors of society per annum. Of these, 52 percent are women. Yet alien plants now cover more than 20 million hectares in the country, spreading at an exponential rate. It is estimated that invasive alien species are causing billions of Rands of damage to South Africa’s economy every year[59].

From the very start, the programme has been using labour-intensive work methods. Originally, works were implemented through force account operations. Today, the works are executed through the engagement of local small-scale contractors who are responsible for the recruitment and organization of the workers. The contractors have been recruited

[59] Of the estimated 9000 plants introduced to South Africa, 198 are currently classified as being invasive. It is estimated that these plants cover about 10 percent of the country .

from the workforce and given training in how to operate a small business entity. They have also been provided extensive training in the plant eradication methods, correct and safe use of herbicides and the organization of the work. In addition, the workers are offered accredited training courses in the same fashion as in the other E&C Sector programmes, thereby strengthening their position in terms of finding alternative work when the project on which they are employed is completed.

- "**Working on fire**": It is estimated that annually there are on average 30,000 land fires burning 3 million hectares of land in South Africa. Working on Fire has over 200 fire fighting bases across the country, each with a team of 25 qualified persons. These crews mainly use hand tools to fight fires, but can call on aerial support should the fire danger escalate, ranging from purpose-built water bombers to helicopters and spotter planes. They have a highly specialized land transport fleet to deploy fire fighting crews and resources into fire hotspots. Outside the fire season, the crews are involved in fire prevention interventions such as cutting firebreaks and clearing fuel loads. They also work in local communities to inform them about fire risks and to build an appreciation of the potential benefits of responsible custodianship of their environment.

  Working on Fire employs and trains young men and women from marginalized communities to become skilled fire fighters. After passing a stringent fitness test, recruits are put through rigorous training based on national and international standards. On average, some 54 percent of the government funds are spent on wages with an additional 24 percent spent on indirect employee costs such as training, personal protective equipment and transport. The management of the Working on Fire programme is outsourced to a consortium of companies specializing in fire management.

- **Working for Wetlands.** As a dry country, South Africa gives high value to the water-related services that wetlands provide. By 2025, it will be one of fourteen African countries classified as subject to water scarcity (less than $1000m^3$ per person, per year). Wetlands currently rank among the most threatened ecosystems in South Africa. A national survey has mapped about 300 000 wetland units covering a total area of 2.9 million hectares, or 2.4 percent of South Africa's surface area. Recent studies reveal that 65 percent of wetlands are under threat (48 percent critically endangered, 12 percent endangered and 5 percent vulnerable). Since its inception, "Working for Wetlands" has invested 530 million Rands in the rehabilitation of 906 wetlands, thereby improving or securing the health of more than 70,000 hectares of wetland area – or roughly 5 percent of threatened wetlands ..the challenge remains .

- **Working for the coast .** South Africa has just over 3000 km of coastline, with a wide range of highly sensitive habitats including rocky and sandy shores, kelp forests, coral reefs, mangroves, lagoons, estuaries, salt marshes, cliffs, dunes and coastal forests. Coastal and marine resources are vital to South Africa's economy and future prosperity. Estimates put the value of these resources at 35 percent of Gross Domestic Product[60]. Working for the Coast was initiated in 2000 under the Social Responsibility Programme, which provides jobs and training for unemployed people in coastal communities to create and maintain a cleaner coastal environment. Covering nearly 90 percent of the country's coastline, it works with municipalities and conservation agencies to ensure the sustainable use of the coast's natural resources.

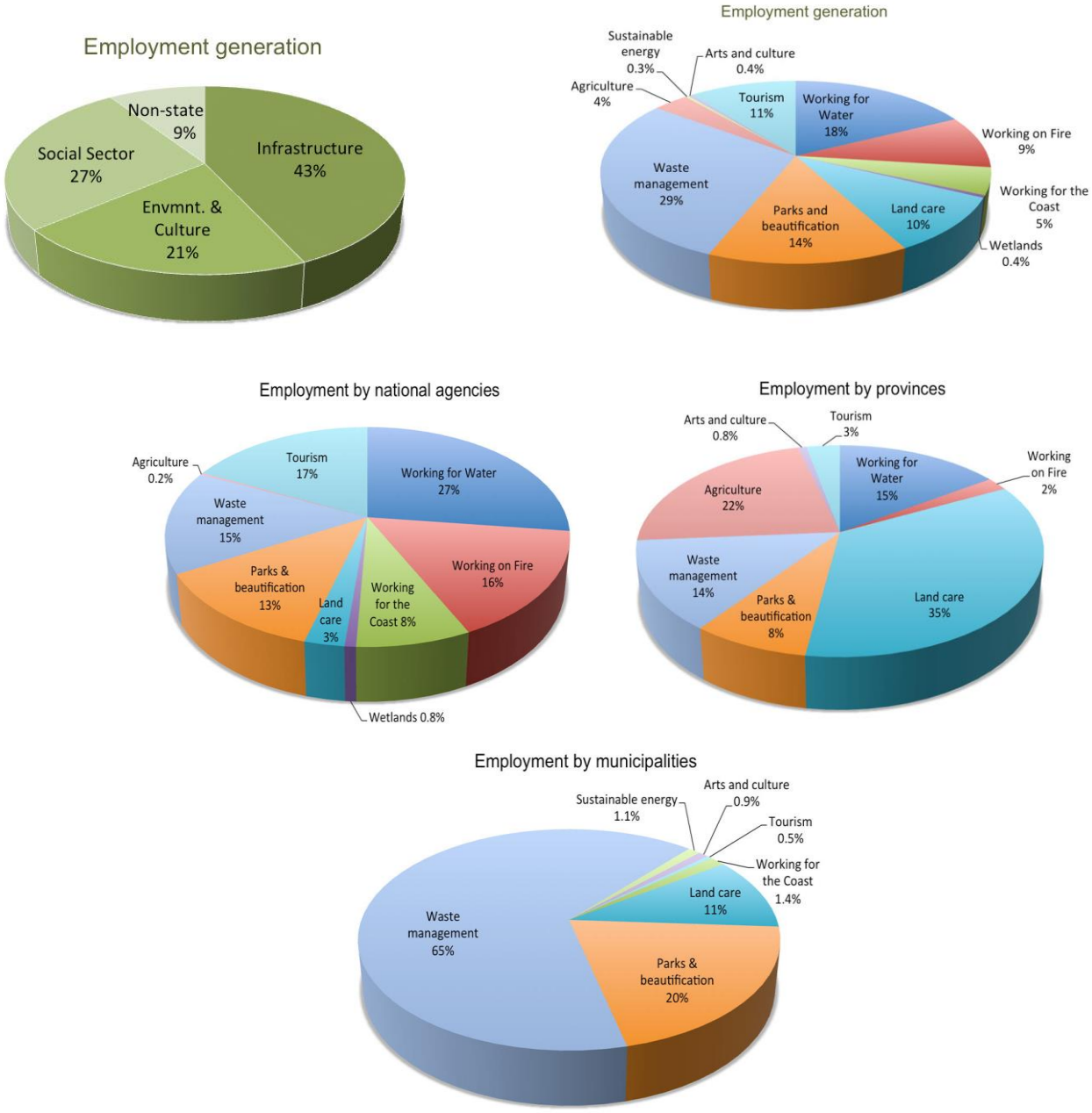
- **Land Care Programme .** LandCare is a community-based and government supported approach to the sustainable management and use of natural agricultural resources. The goal

[60] Source: CoastCARE South African Coastal Information Centre, www.sacoast.ioisa.org.za

of the Land Care Programme is to develop and implement integrated approaches to natural resource management, which are efficient, sustainable, equitable, and consistent with the principles of ecologically sustainable development. Most Land Care projects are implemented by the provincial agriculture departments. Works include labour-intensive soil conservation related to livestock farming, de-silting dams, stabilizing degraded land, installing anti-erosion structures, contour planting, replanting pastures, refurbishing irrigation systems, tree planting, wetland conservation and training communities in conservation practices.

Achievements of EPWP in terms of employment generation. With by far the largest budgets, the Infrastructure Sector remains the largest employer creating 43 percent of the workdays generated by the EPWP. The Social Sector is the second largest employer producing 27 percent of all workdays with the Environment and Culture (E&C) Sector following with 21 percent of all work. The labour intensity rates in the E&C programmes are in the range of 30 to 40 percent. These rates are considerably higher than in the Infrastructure Sector where they are typically between 3 and 25 percent, depending on the type of works. Besides, job "creation" in the infrastructure sector is almost 4 times costlier than in the EC sector (due to both the lower labour-intensity rate and the considerably higher inputs needed in machinery and materials). The average duration of employment - a figure derived from the number of total workdays and work opportunities in each of EPWP's (sub)programmes- is in the range of 3 to 4 months. The exception is the "Working on Fire" programme where the duration appears to be at an average of 7.7 months. As these figures only relate to one financial year, they do not reflect the fact that some of these work opportunities may stretch from one year into the next. About 80percent of total employment and of expenditures in E&C activities take place in rural areas. Current projections are that the E&C programmes will generate a total of 230,000 FTE jobs by 2025 , nearly half of them in the WfW (sub) programme ***Monitoring and evaluation of EPWP***. Extensive data acquisition systems (including a customized GIS) are in place but, because some of the (sub)programmes pre-existed EPWP, there are separate systems with a significant amount of overlap and a lack of harmonization in terms of work contents. Streamlining the classification of projects could facilitate improved reporting of work outputs. The monitoring of physical outputs is a useful tool for the evaluation of individual as well as clusters of projects. With the reported outputs, it is possible to calculate the specific costs of such works as well as monitor productivity rates. Productivity and cost rates are important indicators of how effective the works are organised and implemented. The evaluation of such rates can also form part of the basis for decisions on where to provide or increase technical support and training.

Fig. A1 Employment generation by SA's EPWP: (a) as a whole; (b) EC sector alone ; (c) EC sector outputs per type of implementing agencies (source:. Lepono & Johannesen :"Enhancing the application of labour-intensive methods in the EPWP's Environment and Culture sector " , a report to ILO, 2013)



A.3. Water bodies restoration :

A.3.1 India's Repair, Renovation and Restoration (RRR) schemes

After a five-years pilot period, the Government of India (GoI) approved in 2009 two schemes on repair, renovation and restoration (RRR) of water bodies (including traditional "tanks"/ponds, of which India has over half a million): (i) one with external assistance and (ii) the other with domestic support. GoI provides assistance to the extent of 25 percent and borrows the necessary funds from the World Bank, whereas the remainder 75 percent is to be borrowed from the World Bank by the concerned State. Under the scheme with domestic support, about 100,000 water bodies having a command area of 900,000 ha. were to be covered; funding is also in the ratio of 25:75 (Centre: State) for non-special category States and in the ratio of 90:10 for special category States (drought prone/ tribal areas).

The RRR includes the comprehensive improvement of water bodies, catchment area treatment, command area development and capacity building of stakeholders. Targeted benefits under the project will include: (i) the creation of additional irrigation potential, the increase of agriculture / horticulture / pisciculture production and productivity – with potential job creations, (ii) the increase in recharge of ground water, improvement in water use efficiency, increase in availability of drinking water, positive impact on water quality, (iii) promotion of tourism and culture.

A.4 -Afforestation/Reforestation

A.4.1 Grain for Green Programme (GGP) in China .

China's natural resources base has paid an expensive price for the country's remarkable economic growth, including large-scale deforestation and desertification: in the past five decades vast forest lands and grasslands have been reclaimed into farmlands due to pressure arising from increasing population and grain demand. This practice has aggravated soil and water erosion and land desertification.

The GGP programme - also known as the Conversion of Cropland to Forest and Grassland Program or the Sloping Land Conversion Program - was introduced in 1999 in China, with the aim of reforesting uplands to reduce erosion, downstream flooding and rural poverty. The GGP involved the conversion of steep-sloped (greater than 25 degrees), degraded cropland and barren land into forest and grassland with the intent of reducing soil erosion, enhancing biodiversity, and conserving natural resources The primary areas targeted by the GGP were the upper and middle reaches of the Yellow River and Yangtze River . There are more than 6 million ha of farmland with a slope of over 25 degrees in China, and it is estimated[61] that two-thirds of the annual volume of silt flowing into the Yangtze River and Yellow River come from sloped farmlands.

The program was designed to retire farmland that is susceptible to soil erosion, although some farmers may go back to farming the land after the program ends; it also included reforestation of barren lands. The incentive consisted of providing grain, saplings and/or subsidies, over a period of five to eight years in the first phase, to be extended for another five to eight years, in order to encourage up to 30 million rural households to voluntarily convert part of

[61] Li Zhiyong 2003. A policy review on watershed protection and poverty alleviation by the Grain for Green Programme in China , Proceedings of the Workshop: Forests for Poverty Reduction: Opportunities with Clean Development Mechanism, Environmental Services and Biodiversity, Seoul 27-29 August 2003 http://www.fao.org/docrep/008/ae537e/ae537e0j.htm

their cropland to forest/grassland, especiallyon slopes. To support this strategy, the forest law was revised to recognize the importance of compensation in return for environmental services[62].

The central government used fiscal transfer payments to offset the reduction in public revenues caused by the GFG, while local governments were expected to contribute to transport and training expenses. From the trial phase to full implementation, GGP applied a top-down procedure implemented by a vertical administrative hierarchy. The interest of farmers, considered core implementers of the programme, was especially high, as the level of compensation sometimes exceeded the previous agricultural revenues[63]. Those conditions led to a spectacular development of agroforestry technologies after 2001, mainly through fruit tree intercropping. By the end of 2012, the GGP claimed to have converted 9.06 million ha of cropland[64] to forest and 0.64 million ha of cropland to grassland in 25 provinces and autonomous regions[65].

As regards a potential competition with food production, a study[66] showed that GGP had only a small effect on China's grain production and almost no effect on prices or food imports (Xu.et.al. 2005). However, after a rapid rise and a huge peak in activities in 2003 (at near 4 million ha reportedly reforested on that year), the central government greatly reduced the size of the program. By 2007, the government had spent 158 billion RMB on subsidies (of which 78 percent in the form of grain) for the GGP[67]. A meta analysis of local studies suggests that the GGP induced improvement in vegetation conditions and may alleviate soil erosion and enhance carbon sequestration in the Loess Plateau[68]. However, the potential for the GGP to provide long-term positive ecological effects requires further study. In particular, the low survival rates (from 20 to 60 percent) of planted trees has been pointed out as being far from the central government's objective of 80 percent. The actual expense of maintaining the newly planted trees proved to be much higher than anticipated by the central planners, and farmers did not receive sufficient annual subsidy after plantation to carry out this work. Often, the farmers were left with no choice than to reoccupy the reforested land.

This experience shows the power and the limits of a "campaign-style" approach to reforestation and NRM in general. Such approach is effective in mobilizing local officials and the public so as to achieve the set government's targets in an impressive way in the short-term , yet it favors a mindset of achieving quantitative "results" at the expense of quality and the sustainability of the improvements.

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[62] Farmers are entitled by law to go through procedures for changes in land use and be provided with certificates of tenure of the tree crops they planted. The contracting-out duration would extend to 50 years after farmers have established plantations on farmlands and barren hills. Farmers are entitled by law to inherit and transfer the contract and extend it upon expiration in conformity with relevant laws and regulations.

[63] 2250 kg of grain were subsidized annually for each hectare of converted farmland in the Yangtze River catchment and southern region and 1500 kg of grain for each hectare of converted farmland in the Yellow River catchment and northern region, whereas on average sloped farmland in these mostly impoverished land with poor water supply and fertility, serious soil and water erosion threats degrees produces only 1770 kg of grain per hectare

[64] This represents about 6percent of all China's cultivated area

[65]Song, X., Peng, C., Zhou, G. et al. 2015. Chinese Grain for Green Program led to highly increased soil organic carbon levels: A meta-analysis. Sci Rep 4, 4460. https://doi.org/10.1038/srep04460

[66]Xu Z., Xu J., Deng X., Huang J., Uchida E. and RozelleS. 2005. Grain for Green versus Grain: Conflict between Food Security and Conservation Set-Aside in China, World Development Vol. 34, No. 1, pp. 130–148

[67] Cheng J. Y.S. 2012. China: A New Stage of Development for an Emerging Superpower, City University of Hong Kong, Hong Kong.

[68] Ibid.

Data on the employment impact of the GGP are scarce and it is difficult to isolate the impact of the GGP from other strong drivers prevailing in rural China such as other self –employment and wage income from local and migrant job markets.[69]. The government clearly expressed an expectation that the program would facilitate a shift in labor from low-profit grain production to the production of more profitable crops and of livestock and, more importantly, from primarily on-farm work to greater off-farm work. The conservation set-aside program also can indirectly induce structural change in household wealth by reducing the demand for labor for cultivating crops. How the freed-up labor time gets reallocated critically depends on the other physical resources possessed by the household, the household's stock of human capital and preferences.

Farmers can invest the compensation that they receive into investments or activities that will aid them in switching to higher value crops and livestock as well as other productive activities, particularly off-farm endeavors. However, the costs associated with migration—and with funding the investment needed to start a family-owned business—can be high for households living in poor mountainous areas.

An extensive survey carried out in 2004[70] supported the view that the compensation paid by GGP for setting aside cultivated land has been relaxing the liquidity constraint for participating households, allowing participants to more readily move into the off-farm employment sector (relative to non-participants). It has been suggested that to enhance this effect, additional support to vulnerable populations may be needed, such as job training. Rural migration should be channeled through the development of small townships, the creation of employment opportunities and new skills training in order to improve the adaptability of the migrants and prevent their flowing to large cities.

[69] Uchida E., Rozelle S. and Xu J. 2009.Conservation Payments, Liquidity Constraints and Off-Farm Labor: Impact of the Grain for Green Program on Rural Households in China, American Journal of Agricultural Economics Vol. 91, No. 1 (Feb., 2009), pp. 70-86 (17 pages)
[70] Ibid.

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