A GLOBAL ACTION PLAN FOR THE RESTORATION OF NATURAL WATER CYCLES AND CLIMATE

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*A global plan of climate restoration of the **small water cycle**[1] of regional landscapes, with a goal of decreasing floods, drought, natural disasters, and other undesirable climate changes, and increasing the biodiversity and production potential of all continents, through the introduction of various measures of rainwater retention suitable for all areas of human habitation and usage.*

The Mulloon Institute in New South Wales, Australia is committed to developing the knowledge and practical experience required to advance regenerative land and water management techniques, including but not limited to permaculture techniques for soil hydration and natural sequence farming, and rural landscape management techniques aimed at restoring natural water cycles that allow the land to flourish despite drought conditions.
See http://themullooninstitute.org/ and http://www.nsfarming.com/.

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[1] see Definition of Terms, Appendix

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1. WHY IS A GLOBAL ACTION PLAN (GAP) NEEDED?

Water management policies worldwide are typically based on the principle of what can be termed the "old water paradigm," which assumes among many other considerations, that surface waters are the main source and reserve of fresh water supplies. Global legislation and investment therefore tend to be oriented toward protecting, developing, and utilizing surface waters with infrastructure such as large reservoirs for water collection and distribution. Although rainwater is the cyclical source of all fresh-water supplies, it is nonetheless often considered to be waste product to be drained away quickly into streams and rivers.

There is a need to perceive by way of a "new water paradigm,"1 that in natural ecosystems, water is integrated into small, regional water cycles, which supply vapor to the atmosphere to condense and form rain, the sun being the driving force of the circulation of water in small water cycles. We also need to appreciate the thermoregulatory processes provided by the movement of water between the surface of the earth and the atmosphere, which maintains the proper temperatures for life on earth[2].

There needs to be increased attention on the gradual, sometimes almost imperceptible impacts of human activities that have led to the reduction of continental freshwater stocks. There is often a misconception that human activities have no direct effect on water cycles, and that temporal and spatial changes are either part of natural, evolutionary processes, or caused by global climate change. Therefore we tend to underestimate the influence of continental freshwater reserves on global energy and thermoregulatory processes, as well as the degrading effects of climate change related to excessive drainage of ecosystems. These human impacts can detrimentally affect extensive territories; these include not only traditionally arid landscapes, but also areas of higher rainfall where human infrastructure drains water away from the land, ultimately to accumulate in the oceans.

The result is a drying up of ecosystems. Two major mechanisms at work are deforestation and agriculture, accompanied by increased stormwater runoff and soil erosion, and reduction of organic matter in the soil, leading to a lessened ability of the land to hold moisture. Another cause is the man-made proliferation of impervious surfaces such as pavement and rooftops that tend to move rainwater rapidly and directly into streams and rivers via storm drains. In this way we treat natural rainfall as a waste product, preventing it from soaking into the landscape and entering the local small water cycle. These local events add up on a continental scale to a significant reduction of groundwater, moisture for soil and vegetation, and water vapor for the air above the continents.

Worldwide, there is no data that demonstrates exactly how much rainwater is lost from small water cycles annually from the continents to the oceans. Research in the nation of Slovakia shows an annual loss of 250 million m^3 through drainage[3]. Based on the assumption that Slovakia has an average rate of dehydration from degraded landscapes, it follows that globally there could be a loss of 760 km^3 of rain-water, which had previously been included in small water cycles. This corresponds to a resulting 2.1 mm rise per year of ocean levels. Here we may find a direct link between the drying of the continents and rising sea levels. Also contributing to the rising levels is fossil water that is pumped from underground and not returned to the hydrological cycle, but instead made to flow to the oceans; this annual increase is 0.8 mm[4]. Since 1993, sea levels have risen annually by 3.3 ± 0.4 mm[5], which corresponds to the estimated total volume of water drained from the continents.

2 New Water Paradigm - Water for the Recovery of the Climate, Municipalia, 2007, www.waterparadigm.org, p 72-73

3 Michal Kravčík, at all: Water for the Third Millenium- „Neubližujme vode, aby ona neubližovala nám“, Typopress 2000 in Slovak, 2003 in English

4 http://www.sciencealert.com/features/20122305-23410-2.html?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%253A+sciencealert-latestfeatures+%2528ScienceAlert-Latest+Features%2529

5 http://www.sciencemag.org/content/328/5985/1517.full

Not enough attention has been given to studying the effects of ecosystem draining and increasing drought. We therefore present here the context for understanding the impact of ecosystem drainage, leading to the expansion of drought across continents, along with rising sea levels. As mentioned previously, the drainage occurs mainly because of deforestation, agriculture and urbanization of the earth's surface. Annual estimates are 127 000 square kilometers of forests lost and 55 000 square kilometers of impervious surfaces added. We also know that over the course of history an area of 50 million square kilometers of forests have been transformed into agricultural land and urban areas. All of these man made changes to the land have reduced water available for small water cycles. It is estimated that over the last century damaged ecosystems have lost 37 000 km^3 of fresh water from their small water cycles. This volume corresponds to a sea level rise of approximately 10 cm. The deforestation and urbanization of the past 20 years with a resulting annual fresh water loss of 760 km^3 is relatively easy to quantify. There is urgent need for a global program of water conservation for the purpose of restoring this lost water back into small water cycles.

One cubic meter of water, either on the earth's surface or in vegetation, consumes 680 kWh of solar energy[6]. In the last 100 years' loss of 37 000 km^3 freshwater from small water cycles to the oceans, the influence of continental drainage has increased the annual production of **sensible heat**[7] to the atmosphere by more than 25 million TWh. This energy volume is more than 1,600 times the annual production of energy created by all the power plants in the world. This influx of energy into the atmosphere is concentrated principally in areas of clear cut forestland and in the extensive impervious surfaces of large cities. The result is large-scale **heat islands**[8], that affect the circulating currents of air masses in the atmosphere. In turn this is related to temporal and spatial changes in precipitation distribution, with a resulting increase in extremes of weather. Globally such changes include a significant decrease of rainfall in drier areas, with dramatic increases of precipitation in colder regions.

On a global scale, heat islands in drier continents interact with colder air masses, bringing chaotic circulating air currents to ocean and forested areas. Increasing chaotic weather is the result. Such unpredictable weather can include frequent winter warm spells In Europe while at the same time the North American continent experiences extremely cold winters. The cause of these weather changes can be traced to large areas of increased sensible heat production in Africa and southern Europe; the resulting heated air pushes air masses to the north of Europe, over the North Pole, forcing Arctic cold into Canada and the United States. There is also a link between drought and intense downpours, a phenomenon scientists have named "flying rivers"[9].

Heat islands are expanding worldwide, resulting in changes in the distribution of precipitation. A demarcation point may be drawn between damaged lands producing sensible heat and healthy lands simultaneously producing **latent heat**[10] from the earth's surface to the atmosphere. Some areas are experiencing a decrease in precipitation, associated with dehydration of the land from extensive agriculture or urbanization, while other less damaged areas are experiencing intense rainstorms from enhanced vertical accumulation of clouds[11]. Thus heat islands increase the risk of vertical cloud accumulation in the atmosphere above healthy ecosystems. This phenomenon increases the likelihood of even more dramatic increases in severity of the weather including windstorms, tornadoes, and even hurricanes[12].

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6 New Water Paradigm – Water for Recovery of the Climate, Municipalia, 2007, www.waterparadigm.org
7 see Definition of Terms, Appendix
8 see Definition of Terms, Appendix
9 http://www.theguardian.com/environment/2014/sep/15/drought-bites-as-amazons-flying-rivers-dry-up
10 see Definition of Terms, Appendix
11 http://thevane.gawker.com/maps-which-parts-of-the-u-s-see-flash-floods-most-oft-1622076723
12 http://realtruth.org/articles/120414-001.html

The United States is a prime example of weather extremes resulting from ecosystem damage. An inland heat island effect leads to increasingly prolonged droughts, interspersed with frequent tornadoes and intense downpours in extensive agricultural areas of the United States (from the state of Kansas radiating outward)[13]. The same effect, while preventing cloud formation in the interior, also leads to excessive vertical cloud accumulation on the humid East Coast[14]. Thus the severity of so called superstorms, accompanied by widespread flooding, on the eastern seaboard can be traced to the production of sensible heat in dried out areas of the country's interior. In California, on the West Coast, prolonged droughts are associated with deliberate draining of the land that can be traced back to the nineteenth century.

The next issue to consider is the impact that drainage of continents has on the earth's crust. There is a high probability that the weight of the drained water, about 37 000 km^3, having been removed from the continents and added to the oceans, will affect pressure conditions inside the geological structures of the earth. Altering the tension in the earth's crust presents a realistic prospect of more frequent earthquakes in the future. According to the IPCC Panel, water levels in the oceans have increased by about 15 cm in the last hundred years[15]. There are no active simulation models available that link pressure changes in the earth's crust with earthquakes. However, research on the impacts of tropical cyclones, and subsequent activation of earthquakes in Taiwan and Haiti, link the impact of large amounts of eroded soil during floods with subsequent activation of an earthquake[16]. Changes in the earth's crust brought about by drying of the ecosystems by heat islands, however, is a little studied although identifiable human impact.

Increasing production of sensible heat causes a decrease of rainfall in dry areas and an increase in wetter and colder areas; it also increases thermal differences between the drier, hotter areas and cooler, humid areas. This is demonstrated by the principle of the biotic pump[17], which shows that the degradation of ecosystems is causing a decrease of inland precipitation. Even small changes in rainfall amounts and distribution can lead to ecosystem damage. Research in Georgia in the Caucasus confirms this through records of historical rainfall changes linked with ecosystem degradation[18]. Another example is the island of Hawaii in the Pacific, where an area of 10 000 square kilometers encompasses ten precipitation bands. While the western part of the island receives only 250 mm rainfall per year, the northeastern portion is drenched with more than 6 000 mm annually. Modern science describes this phenomenon as the impact of the **mountain massif**[19], which causes condensation of clouds before they reach the western side of the island. In this case, the interior of the island comprises mountain ranges containing stretches of active volcanoes, with crests exceeding three thousand meters above sea level.

It is not yet widely known that **sensible heat**[20] production, from heated dry land areas, produces a very significant effect by both increasing precipitation in wet areas and decreasing precipitation in dry areas. As mentioned above, historical temporal and spatial changes have occurred in Caucasus, Georgia, over a 10 000 year period; these changes confirm the impact of land use as evidenced by a rise in precipitation and temperature differences among the region's climatic zones. Additional confirmation comes from changes that have occurred in the hydrological cycle of the island of Cyprus. Here rainfall has decreased by more than 15 per cent, despite the fact that water is captured by more than 100 dams in an area of almost 10 000 square kilometers. Water problems on Cyprus continue to increase every

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13 http://www.ldeo.columbia.edu/res/div/ocp/pub/cook/Cook_Seager_Cane_Stahle.pdf
14 http://nca2014.globalchange.gov/highlights/overview/overview
15 https://www.ipcc.ch/ipccreports/far/wg_I/ipcc_far_wg_I_chapter_09.pdf
16 http://www.miami.edu/index.php/news/releases/study_links_tropical_cyclones_to_earthquakes/
17 http://www.hydrol-earth-syst-sci.net/11/1013/2007/hess-11-1013-2007.html
18 https://minerva-access.unimelb.edu.au/handle/11343/39418
19 see Definition of Terms, Appendix
20 see Definition of Terms, Appendix

year; if a comprehensive program of ecosystem rainwater conservation is not implemented within the next decade, Cyprus could face a crisis situation of water scarcity.

From the aforementioned statements, it can be seen that drainage from degraded lands, causing subsequent drying of their ecosystems, can have a profound effect, contributing to climate extremes. Such phenomena occurring in drained, dried areas are often explained as an impact from a greenhouse gas effect from increased levels of CO2 in the atmosphere. A growing number of recent scientific papers, however, have increased our knowledge of the climatic impact of damaged and degraded small water cycles associated with decreased and damaged vegetation. Water cycles and vegetation have functioned together in coexistence over geological eons, this relationship being disrupted historically and currently by humans practicing poor land management[21]. Giving attention only to the greenhouse gas model of climate change, while ignoring land mismanagement, may result in a large part of harmful human activity not being addressed, therefore preventing global implementation of effective measures.

Conclusion and Action Needed

For climate change due to anthropogenic drainage and vegetation depletion, the major necessary intervention is to restore water in dry, damaged ecosystems, a measure which can be achieved with rainwater retention and soil erosion control. Consistent and widespread restoration of native vegetation and soil fertility will bring about restoration of the natural water cycle. It will also achieve increases in food production, fresh water supplies, and biodiversity, while mitigating the occurrence of severe weather, and decreasing the volumes of storm water flowing down rivers, thus ultimately decreasing sea levels. This can be accomplished; it is only necessary to mobilize stakeholders, from local and regional to national, international, and global levels.

Despite the above-described realities of the deterioration of water cycles, and that water as a resource is extremely critical to many public investments, current efforts are insufficiently responsive to the nature and dynamics of the ecological processes taking place. Hydrological cycles have been negatively affected in many types of forested, agricultural, and urban landscapes, as well as in the transportation and industrial infrastructure and other developed areas. These intensive human-caused effects accelerated in the twentieth century, especially in recent decades.

Unfortunately, a large proportion of urban infrastructure (such as impervious surfaces and storm sewer systems) is encouraging the continued drying of the landscape ecology, which not only compromises the balance of water, but also causes an increase in urban heat islands; subsequent changes in rainfall distribution indicate an altered local and regional climate. The loss of water into rivers also contributes to rising sea levels. By not taking these effects into consideration, high level decision makers and global stakeholders are operating under the inaccurate concept that all climate change can be mitigated solely through the reduction of greenhouse gases.

Forecasts suggest that stable hydrological regimes in landscape ecosystems are the key determining factor of economic, social, and cultural welfare of all human communities, from local to global scale. Such landscapes are far more equipped to absorb rainwater and withstand extreme weather such as intense rains and drought. Such a desirable state can be achieved only by ecosystem improvements that strengthen biodiversity and soil production potential through improved hydrological regimes.

Current knowledge of hydrology in ecosystems worldwide, indicates that without a fundamental change in land and rainwater management, especially in urban areas, the risk of extreme floods and droughts will rise in coming years. Problems of overheating and drying will increase exponentially if we do not

[21] Huryna, Hanna: Effect of different types of ecosystems on their meteorological conditions and energy balance components, University of South Bohemia, České Budejovice, 2014

stop the perennial surface drainage of landscapes. The solution is to restore degraded landscapes by means of natural regeneration of soil moisture to benefit small water cycles. This will create favorable conditions for prevention of floods, droughts, and other natural disasters.

Massive rainwater retention is necessary to achieve a state of sustainable life on our planet; it is time to mobilize politicians together with citizens. The challenge is to make urgently needed decisions to achieve an integrated, holistic system of rainwater management. By doing so, in addition to preventing floods and droughts, we will also strengthen biodiversity, increase soil fertility and productivity, and restore a more healthful climate.

In varying degrees, activities of human civilization adversely affect water in the landscape. It is imperative that we identify those activities and supply necessary interventions that systematically provide comprehensive rainwater storage to landscape ecosystems. It is also necessary to identify actions that will restore damaged landscapes and thus reduce current negative human impacts.

Although floods and droughts are to some degree natural phenomena, major human interference in natural processes includes changes in stormwater runoff from urbanization, faulty agricultural practices, and deforestation; these have significantly altered the state of water in ecosystems worldwide. The result is increased risk of floods, loss of soil productivity and biodiversity, as well as contributing significantly to climate change. Thus, nature has become quite vulnerable.

What is needed are not new, larger water projects based on the principle of the old water paradigm, but instead ecosystem water protection achieved through water restoration in soil and landscapes, the basic principle being simple in concept: As much as possible harvest rainwater where it falls.

Inappropriate human interference with natural processes must be stopped; governments have the responsibility to support water management policy which is consistent with environmental protection and landscape conservation.

Transferring water management problems from one region to another will do nothing to alleviate climate problems caused by poor land management. The only suitable strategy for such climate recovery is a three-step approach: 1) capture, and 2) retain rainwater in the landscape, and 3) transfer only the excess that cannot be retained into watercourses. Integrated water resources management covering an entire river basin must have priority over flood risk management restricted to isolated stream sections.

This approach makes it possible to recover the health and climate of an entire watershed in an efficient, inexpensive and sustainable manner.

Jan Lambert photo

NATURAL WETLAND: USA- State of Vermont- Natural wetlands provide valuable rainwater retention as well as important wildlife habitat.

2. GAP BACKGROUND

The requirements for an effective approach to comprehensive, integrated flood protection are not being provided by the predominant concepts and methodologies. Protection is needed for watershed ecosystems on a global scale, in order to mitigate not only floods, but drought and other natural disasters, particularly associated with climate change, now and into the future.

A welcome start has been made through some efforts at global and continental legal standards and strategic decisions concerning floods, drought, and climate change; namely, the EU Water Framework Directive[22] and the Millennium Development Goals[23], among other global climate protection programs. Implementation of these programs is slow, however, as there is not enough provision for strengthening the ability of communities to solve their local water problems.

The urgency of the need to address protection against floods, drought and climate change was confirmed by the Council of Europe for the Environment, which in December 2012 adopted a new water policy based on a directive for water retention[24]. The EU included as background information, the Slovak government's Program of Landscape Revitalization and Integrated River Basin Management, adopted in October 2010[25] and launched in the spring of 2011 to reduce flood risk, drought and other risks of sudden natural disasters.

The Slovak program is based on a concept of social responsibility for protecting its watershed ecosystems against floods, drought and climate change. It is also based in part on the Millennium Development Goals and other documents cited by directors in the field of EU water policy.

2.1. Global millennium goals

Humanity and environment have formed a circular relationship: environment impacts human life and likewise all human activity impacts the environment. Deterioration of the earth's environment is directly related to global challenges increasingly presented by human populations. Water-related environmental threats are manifested in many forms including global warming, air pollution, loss of forests and biodiversity, desertification and soil degradation, diminished drinking water supplies, and river and ocean pollution. To address all these problems, as well as other environmental threats such as air pollution and genetically modified crops, what is necessary is a sustainable development strategy on a global scale.

To reach a sustainable strategy, the current Millennium Development Goals for climate recovery need to comprise not only climate change mitigation, but also expanded strategies to bring about healing processes in the climate. These are needed further to assure abundance of clean water for human use and for biodiversity, reduction of desertification and expansion of forests, increased soil fertility, and reducing ocean pollution and sea levels for the wellbeing of island and coastal areas.

2.2. New water management policies of the United Nations

New, expanded water management policies will enable the United Nations to carry out its strategic decision to focus on green growth, efficient use of natural resources, and resilience to natural disasters; economic security will be increased not only in the water sector, but also related sectors that encourage and foster innovation for sustainable communities and economic prosperity of nations. By means of restoration of ecosystems and water retention strategies, UN member countries can ensure their water

[22] http://ec.europa.eu/environment/water/water-framework/index_en.html
[23] http://www.unmillenniumproject.org/goals/
[24] http://ec.europa.eu/environment/water/blueprint/index_en.htm
[25] http://archiv.vlada.gov.sk/krajina/data/files/7183.pdf

security by using the best available techniques and measures. They can reduce the vulnerability of their own countries to floods, droughts, and natural disasters, while simultaneously improving soil fertility, biodiversity, groundwater supplies, and the moderating effect of small water cycles on regional climates. Joining with other nations in a united effort will help bring about environmental healing on a global scale.

Effective land management and planning for all countries requires strategies devised to permeate landscapes with adequate levels of rainfall and snowmelt, which will bring about the return of stable regional, small water cycles to aid in local, and ultimately global, climate recovery. Restoration of vegetation and water in urban and rural landscapes will improve each country's ability to retain water and thus improve the functions of ecosystems. The highest priority is the retaining of rainwater where it falls, especially in areas altered by human activities. Improving the infiltration of rainwater into the soil to an optimal saturation level will increase ground and surface water resources, and thus vegetation, soil fertility, social benefits and economic prosperity. Of utmost importance is the prospect of establishing permanent vegetation cover and replenished water sources, which will help ensure livable climates for all countries.

2.3. Programs of landscape restoration and integrated river basin management

All of the world's continents are suffering from floods, droughts, forest and grassland fires, diminished groundwater, and undesirable climate changes. In economic terms, the damage has exceeded billions in US dollars annually, and continues to rise. At the same time economic crises have substantially increased unemployment. And yet, an opportunity arises now to solve the above-mentioned problems, by learning from the successes of the 1930s New Deal Program in the United States[26].

Instituted by President Franklin Roosevelt during the Great Depression, the American New Deal embraced a large number and variety of initiatives at federal, state, and local levels. Jobs were created in line with Roosevelt's decree that unemployment was a "drug unnoticeably destroying the human spirit." With the benefit of hindsight, we can say that the millions of jobs created also resulted in much healthier landscapes with ponds, water catchments and terraces to slow erosion and soak up rainwater, along with replanted forests. Americans enjoy these benefits to this day.

In January of 2009 at the Davos World Economic Forum, UN Secretary-General Pan Ki-Moon called on the world's leaders to transform the global economic crisis into a "Green New Deal" with new jobs to fight climate change[27]. Ban Ki-Moon called for "a new constellation of international cooperation — governments, civil society and the private sector, working together for a collective good," as well as "breaking the tyranny of short-term thinking in favor of long-term solutions."

At present about 760 km^3 of rainwater are lost from landscapes of the continents annually, through storm runoff failing to be absorbed into the soil. This represents water that should be replenishing soil moisture and groundwater reserves, and stabilizing regional temperatures and rain cycles through the **transpiration** of plants[28]. The necessary goal is to return this lost water back to the continents through deliberate human actions. A variety of possible measures would include terraces, ditches, and swales along the contour lines of slopes; check-dams; and depressions, water-holdings, fire ponds and polders. Many effective measures in rural areas do not require highly skilled labor and could thereby provide jobs for the local unemployed. A global goal of rainwater retention needs to be set, of approximately 1 000 km^3 over the span of 10 years. We estimate that one worker can create water-holdings for 1 000 cubic meters per year. This will translate to 50 million jobs over the next decade.

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[26] http://www.history.com/topics/civilian-conservation-corps
[27] http://www.un.org/apps/news/story.asp?NewsID=29712#.VQdEBU10xjo
[28] see Definition of Terms, Appendix

In 1993 the government of Slovakia had planned to create water supplies by building a dam with a capacity of 700 liters per second, costing 350 million US dollars, that would have threatened the very existence of five historical communities that were over 700 years old. However, the People and Water NGO has developed an alternative to the proposed dam[29]. Their "Blue Alternative" plan is to restore water resources throughout the dehydrated ecosystems covering an area of 5 500 square kilometers, by employing measures that respect the rights of the inhabitants of historic villages and also promote a sustainable lifestyle. The Blue Alternative would provide 4 000 liters per second capacity, adequate for all interests (city water supplies, agriculture, industry, biodiversity) with water retention in the landscape of at least 80 million cubic meters. There would be a similar cost of about 350 million US dollars, but with an estimated minimum of five times the amount of water storage gained.

A small pilot project of the Blue Alternative plan was implemented by volunteers of People and Water in 1996, in a micro-watershed of the small dried up valley of the Torysa River, where water flowed only during heavy rains. Volunteers built slope depressions, water-retention swales, and beam weirs to slow down rapid storm runoff from the steep slopes, successfully retaining rainwater underground. New springs emerged and the formerly dried up valley now enjoys a steady, constant stream flow.

Based on the Blue Alternative's solutions, the Slovak Republic government adopted the *Landscape Revitalization and Integrated River Basin Management Program for the Slovak Republic* (October 2010)[30]. The principal tool for addressing ecosystem problems, as well as flood and drought risks, was rainwater retention improvements in damaged sections of the landscape. A goal was set to restore landscape water retention capacity of at least 250 million cubic meters for the whole of Slovakia.

Within the brief period of 18 months, 488 communities involved in the *Program* achieved 100 000 separate water retention measures in degraded landscapes. A retention capacity of 10 million cubic meters was restored or newly constructed, amounting to four per cent of the total amount proposed during the expected ten-year implementation period. Between October 2010 and March 2012, the *Program* provided 7,700 seasonal jobs, mostly for chronically unemployed workers, who at least were able to benefit from the dignity of socially beneficial, temporary employment[31].

The implemented measures aided in lessening the flooding risks of the torrential rains of 2011; the retained storm water was subsequently released gradually, during the next six months of extreme drought in Slovakia that same year. By setting a priority on water retention measures in the upstream sections of the watersheds, flooding and drought risks were moderated in 500 to 1 000 municipalities located lower in the river basins. Numerous representatives of towns and villages expressed satisfaction with the *Program* after many years of helplessness and worries in regard to the threat of severe storms, flooding, and soil erosion.

[29] http://www.goldmanprize.org/1999/europe
[30] http://archiv.vlada.gov.sk/krajina/data/files/7183.pdf
[31] http://www.ludiaavoda.sk/data/files/44_kravcik-after-us-the-desert-and-the-deluge.pdf

3. GAP OBJECTIVES AND HOW TO ACHIEVE THEM

3.1. Prevention of floods, drought and climate change

The aim of the program is to develop and activate long-term conditions that lead to socially practicable and economically effective functioning of a complex and integrated system of environmental protection, to ensure the prevention of floods, drought and climate change across various ecosystems, water basins, nation states and continents.

The prevention of floods, drought and climate change can be tackled in a three step approach based on the following sequence:

(i) first, capturing rainwater in the eco-system where it falls **– retaining**

(ii) second, accumulation of rainwater in the eco-system **– storing**

(iii) last, releasing the excess rainwater, which the ecosystem is not capable of absorbing **– draining**

The above mentioned approach is in line with the main focus and priorities of the program: **rainwater retention in ecosystems, slowing the runoff of rainwater to enable infiltration, and the revitalization of damaged ecosystems, water basins and territories.**

Preventive measures should be designed in ways that will increase the effectiveness of existing water works establishments to protect against floods and lack of water supply, and increase protection of inhabitants and their health, private and public property, cultural heritage and other material and nonmaterial things.

One of the basic steps for the prevention of floods, drought and climate change will be the restoration of an ecosystem's water basin to its natural self-sustaining state where it will be able to retain rainwater, permit its infiltration into the soil and thus increase the quality of the soil. The restoration of the functions of an ecosystem will revitalize the use of the land for its inhabitants; it will strengthen ecological quality and productive potential in such a way, that water basins will no longer be sources of drought and flooding; at the same time biodiversity will be increased and the climate revitalized.

3.2. Rainwater Retention

The aim of the program is to retain rainwater in a region in order to restore the small water cycle. Rainwater runoff is artificially accelerated within current deteriorated ecosystems. Rainwater on land fulfils various purposes; it significantly contributes to the renewal of an ecosystem's ability to produce water and food, and support biodiversity and a healthy climate. The retention of rainwater in land leads to increased water retention capacity of the landscape, replenishment of underground water aquifers, and thus to increased harvests and biodiversity. Additionally, it mitigates the risk of flooding and drought while alleviating climate change.

The key objective is to create a global program aimed at the development of water retention systems and technical solutions capable of retaining up to 760 m^3 of rainwater across forested, agricultural and urban landscapes worldwide. In turn the proposed water retention measures will require their fair share of maintenance and service in order to retain their functionality. It involves a cyclical process of water retention corresponding to the estimated annual loss of freshwater from the continents resulting from damaged landscapes.[32]

An important factor for increasing the effectiveness of the program, as well as the impacts of the created multiplier effects is the implementation period of the program, necessary for the development of

[32] Ing. Michal Kravčík, CSc. a kolektív: Voda pre tretie tisícročie – „Neubližujme vode, aby ona neubližovala nám“, Typopress 2000.

cyclical water retention capacity. The program time line is expected to be based on both short-term (2020 start) and mid-term (2030 start) horizons dependent upon the global negotiations processes and the ability to commence projects. This program can be initiated across multiple levels; from the global, to continental, national, regional, and all the way down to the local or even individual level. As high level negotiations can be complex, it is much simpler and more effective to start the program from the bottom up at the individual level and expand it to higher levels until it encompasses the entire globe. It has the potential to turn into a global people's movement for the retention of rainwater across all regions, nations and continents.

It is necessary to retain about $100m^3$ of rainwater for every inhabitant on the planet. This means that, if every person on earth implemented measures to retain $100m^3$ of rainwater in their area within one year, enough water retention measures would be achieved to retain more than 760 km^3 of water, which would in turn replenish the small water cycles in the atmosphere above land. This aforementioned rainwater, returned to the small water cycles, would lead to a decrease in ocean levels by 3 mm. Even if some doubts exist about the global program's ability to reduce ocean levels, renew the climate or revive the small water cycles, it is nevertheless legitimate to initiate such a program, based on increased water resources such as that evidenced from an experimental program in the nation of Slovakia. Based on the findings of the Slovakian model, it can be expected that, at the global level, the retention of rainwater on land will result in the increased yield of water resources by more than 30 000 m^3 per second and therefore will kickstart the process of decreasing the production of sensible heat into the atmosphere, with an expected yearly reduction by 500 000 TWh. This will effectively lower the risks of natural disasters as well as occurrences of extreme weather events.

3.3. Revitalization and Restoration of a Damaged Landscape

The restoration of damaged ecosystems is one of the main goals of the GAP, which actively motivates communities, regions and nations to revitalize their local micro-climates. The key condition for the prevention of flooding, drought, climate change, restoration of ecosystems and soil fertility as well as the decline of ocean levels is the retention of rainwater in ecosystems across all continents on earth. In this way, specific local needs are defined by a global solution to the problem. The economic, social, environmental and cultural value of local communities will drastically improve with the systematic retention of rainwater. This trend will lead to the gradual increase in economic competitiveness of a region, even a currently devastated one, which will contribute to global security. Additionally, it will lead to prosperity, social justice, environmental conservation and cultural development, as well as promote biodiversity and global food and water security.

The deployment of a global program for the renewal of the production capacity of ecosystems will provide measures that will slow down the surface runoff of rainwater and allow it to infiltrate into the ground, thus reducing erosion and the risk of flooding. Retention of rainwater on the land's surface and the slowdown of runoff into rivers and seas will increase water reserves across the globe. This will enable rainwater's key functions to develop, which are deemed essential for long-term sustainable development as outlined in the Millennium Goals.

A global program for the retention of rainwater enables the establishment and development of various techniques for the retention of rainwater in forested, agricultural, and urban areas. The program will also align the goals of the retention of rainwater on land with the needs for the revitalization of watercourses and the cyclical flood time adjustment, effectively to protect any given area from disasters and floods.

The focus is on the establishment and subsequent use, spread and development of various techniques for the ecological revitalization of ecosystems, including techniques for rainwater infiltration into the ground. Small scale technical measures on land may be applied in order to serve the various above mentioned purposes, such as flood and drought prevention and climate change mitigation.

3.4. Changes to the mindset

The GAP is primarily aimed at changing the mindset of humankind to consider all water as part of ecosystems, in order to understand water's interactions and complex interconnections. The program will be the source to understanding the multiple global functionalities of rainwater and to the realization of its effective and strategic potential for a wide array of uses.

The contribution of the program in regards to its philosophical basis, is humankind's understanding of the necessity to reduce rainwater runoff from land, where at present, instead of its great utility potential to contribute to the revitalization of ecosystems, it is instead being excessively drained off the land, which leads to flooding during times of intense precipitation.

Part of the program's philosophy calls for a change to land use management, currently heavily focused solely on production, to a more ecologically stable approach with an emphasis on the rehabilitation of damaged ecosystems. This is a necessary action for long-term sustainability of ecosystems and their ability to protect water and biodiversity, reducing the risk of flooding and drought as well as decreasing the damages resulting from natural disasters and extreme weather events.

The GAP supports a transition in the conventional use of ecosystems to a more integrated and holistic approach. The program promotes the revival and development of renewable natural resources (water, soil, vegetation, forests, bio-diversity, etc) and fulfils the demanding conditions set out in the sustainable development goals formulated in Agenda 21 of the Global Millennium Goals.

Michal Kravčík photo

SLOVAKIA: Pavol Šuty is a forest and water specialist, and head of the Skalite Village Flood Prevention Project. The focus of the project is the building of check dam cascades on small streams, to save soil and water for natural stabilization of hydrology and biodiversity. He has experience with building more than 4 000 check dams and other water holdings. In Slovakia more than 100 000 separate water holdings were constructed from 2011 to 2014.

4. PRINCIPLES AND MEASURES OF THE GAP

It is absolutely necessary to implement the recovery plan for the small water cycles on a global scale; therefore we recommend the coordinated development of national action plans in order to strengthen macro-economic effectiveness of the plan.

4.1. Process management at the national level

The Global Action Plan (GAP) for the renewal of small water cycles and climate is based on the principles of activation and management across all continents, focused on the renewal of small water cycles. The goal is the creation of dynamic, interactive and long-term conditions for retaining rainwater on land across the world. The intent is to restore and maintain healthy ecosystems that involve the participation of various stakeholders, including the public sector as well as various private sectors. This action will include effective use and sharing of institutional capacities as well as creative potential and technological resources, creating an integrated multi-sectoral participation model application of the GAP.

4.2. Macroeconomic effectiveness

The financial resources designated for the realization of the Global Action Plan, are from a long-term perspective, the most important criteria for most countries, to ensure environmental, economic, social and climate security for a sustainable way of life. Each country will need to address a multitude of global issues while simultaneously providing enough water for its people, food, the environment, sustainable development and climate. The following social dimensions are an effective measuring tool for macroeconomic performance influenced by the GAP:

- ✓ The effective use of financial resources for the implementation of GAP via legislative measures, which will motivate all landowners and managers to retain rainwater across all ecosystems (forested, agricultural, urban).
- ✓ Systematic support of the utilization of rainwater for multiple uses across all sectors of the economy with incentives for innovation, research and development, services and job creation. These measures will encourage substantial participation of all stakeholders in the use, protection and restoration of water resources on which people, nature and climate depend.

Jan Lambert photo

NATURAL FOREST: USA- State of New Hampshire-Forested areas provide excellent shading, infiltration, and transpiration to regulate small water cycles in the landscape.

5. NATIONAL ACTION PLAN (NAP) TIME FRAME

The Global Action Plan shall be implemented within the next ten years from 2016 to 2025 in three inter-connected stages: global activation of the action plan, activation of the national action plans (NAPs) and their complex implementation within each nation's borders.

5.1. Global activation of the action plan

During the first phase of the action plan, all systematic processes will be set in place, which are essential for a multitude of institutions across the globe to develop systematic measures, in order to reach the common global goal of returning a minimum of 1 000 km^3 of rainwater back to the small water cycles above land annually. Due to ill-advised human activity, rainwater has been gradually drained from the land into the ocean, resulting in a sea level rise of 3mm. Based on these grounds, the United Nations shall accept the role of giving responsibility to all nations for the renewal of small water cycles and recovery of the climate, beginning in 2016, corresponding to the UN's date for mobilizing citizens around the world.

5.2. Activation of National Action Plans

The implementation of each National Action Plan (NAP) will begin the process of returning lost water to the small water cycles and micro-climate of each country. The NAP will bind the governments of individual nations to develop and approve legislative measures and implement the NAP via all stakeholder groups (managers and landowners of forested, agricultural and urban ecosystems).

✓ Legislative Changes
Governments are to support the legislative changes required for the activation of the NAP including the development of interactive mechanisms for its effective application, beginning in 2016.

✓ Kickstarting projects
Within the first year, all governments employing a National Action Plan will be responsible for ensuring the implementation of kickstarting projects in the most damaged regions of their countries, which will in turn become real life test labs for further developing technological processes for capturing and retaining rainwater.

Pilot projects, as an activation phase of the NAP, shall be implemented under binding legislation as well as under the current institutionalized management for integrated protection of water. This provision will provide a useful source and effective feedback for beginning to enact legislative changes and institutional reforms for the effective management, use, protection and renewal of water resources, creating global water security for future generations.

5.3. Regional Program Implementation

This phase of the NAP, within the regions of a country, builds upon the preceding phase and will be deployed after the legislative conditions are in full effect for the large scale implementation of the action plans, for which the conditions are: 1) initial approval of legislation to enable the launch of the NAP, 2) the effective and efficient management of river basins within and between regions, and 3) the established rules and regulations for financing, organizing and managing the NAP.

✓ Multi-Sector Application of the Program
Full functionality of the fundamental principles of the program will not only enable its nationwide implementation of the program, but will also lead to the development of multi-sectoral activities; these will lead to innovation in products and services and will serve as a prerequisite for effective macroeconomic growth and long-term increase in employment.

The scope and complexity of the program and its economic multiplier effects will be further described in chapter 7.

Michal Kravčík photo

SOUTH KOREA: Green Roof Gardens-Moo Young Han, professor at Seoul National University, directs the Rainwater Research Center at the University. He is doing voluntary service of rainwater retention demonstration projects in Korea and developing countries.

Michal Kravčík photo

PORTUGAL-TAMERA - Bernd Mueller is a permaculture and water specialist, and head of Tamera's ecology project. The focus of the ecological work of Tamera is on building the Water Retention Landscape as a far-reaching approach to healing the land, and regenerating water supplies, topsoil, pasture and forest, and greater diversity of species. See www.tamera.org.

6. ACTIVATION OF THE GAP – THE RENEWAL OF SMALL WATER CYCLES

The establishment of a new generation of water-related legislation across all countries of the world will be the result of technical and legal analysis, and documentation primarily focused on the following areas:

6.1. The increased retention of rainwater in degraded ecosystems

Defining activities via the legislative process for increasing the water retention capacity of ecosystems, water basin and entire countries, while simultaneously reducing the risk of flooding, drought, erosion, pollution and other water-related problems, will be identified and specified with established legal rules, tools and mechanisms for the recovery or water in the small water cycle and climate, which will enable:

(1) the reduction of the negative effects of human activities that increase the risk of flooding, drought and climate change.

(2) the activation of the positive effects of human activities that reduce flooding, drought and climate change.

(3) the removal of existing burdens created by past human activity that have increased the risk of flooding, drought and climate change.

(4) consistently applying the mechanisms for negative and positive motivation for the rehabilitation of damaged and dry land, and resolving the consequences of neglecting responsibility or neglecting one's duties based on effective legal norms and standards outlined by the interactive process of legislative changes;

Effective in all water basins, territories of all member countries of the United Nations: • forested land • agricultural land • areas with major waterworks projects • developed transport and industrial infrastructure • urban settings (towns and cities).

6.2. Effective and efficient management of river basins

The legislative process will create conditions for the effective and permanent renewal of water in small water cycles via the integrated protection of water basins and rivers across the world within which all technical and legal aspects will be evaluated, with a particular focus on the following:

(1) Decentralization of water management in river basins, moving toward local stakeholder management where key roles will be carried out by local communities and municipalities:

- ✓ The necessary legislative changes for institutional reform to water management in river basins will support the mobilization of all interested parties for the permanent renewal of water in small water cycles. This should be prepared in all countries on the basis of relevant professional and legal analysis, by developing documentation that will aid in setting up the necessary legal conditions for such transformation; in turn this will strengthen community responsibility for water resource protection and the renewal of water in small water cycles.

(2) Cross-sectoral integrated management of water resources in river basins by increasing the liability of owners and managers of ecosystems with a focus on rainwater retention:

- ✓ Within the agreed-upon legal norms and standards, each country will define the rules and develop a common procedure for the implementation of its national plan for the renewal of the small water cycles and climate, through the accountability of all stake holders for retaining rainwater on damaged landscapes. Integration will be based on the reform of existing institutions through the legislative process, which prescribe the rules and conditions to which all stakeholders must adhere, in order to help pro-tect, use and permanently renew water from small water cycles.

(3) Decentralization of management of newly-created water sources in dried out regions, that have been created as a result of action plans, transferring to owners and managers of newly revitalized land-scapes:

- ✓ Countries with extensive dried out and damaged water basins will develop technical and legal norms and standards that will enable the management of the new water sources resulting from efforts of those implementing action plans to restore water in small water cycles. The programs will prescribe new rules for the economic utilization of new water sources and their sustainability, subject to the conditions laid out in the public interest and in macro economic efficiency.

6.3. Financing, organization and management of the program

The legislative process at the national level will ensure the conditions for long-term financing, orga-nization and management of the program within the complex implementation phase, and will result in:

(1) Operating strategies in which professional economic, financial and legal analyses will be processed, reviewed, evaluated and determined:

- ✓ Financing of the GAP will be supported through the method of provisioning and the legal form of the administering financial resources, by which the scope of financing resources of the program will be formed by international sources stemming from global communities (UN, World Bank),international development funds, state budgets and other financial resources from around the globe.
- ✓ Structured instruments and the conditions for the efficient allocation of financial resources for program implementation will be necessary.

(2) System of organization and management of the program defining the procedures, rules and criteria for submission, approval and monitoring of the program implementation project will be the responsibility of individual nations:

- ✓ At the UN level, quotas will be developed for all member nations, outlining the total capacity of rainwater retention on the principle of sustainable and permanent water renewal in small water cycles, and will further define the priority areas that should have access to international aid due to their extensive drought.
- ✓ The organization of administering and managing the approval and monitoring process of the GAP implementation projects will be the full responsibility of individual countries. Priority areas in countries affected by extensive drought eligible for international assistance will be available in the form of grants whose main purpose will be to kickstart the permanent renewal of water in small water cycles.
- ✓ For determinig the assessment and monitoring the effective use of public resources in the GAP implementation projects, support will be sought from international scientific, technical and educational, as well as independent, institutions that are not subject togovernment structures.
- ✓ The legal form of effective professional management of the program will consist of (i) managerial management (an executive body) and (ii) effective monitoring andcontrols (supervisors).

The World Bank will fund the development of GAP projects for each river basin that extends beyond at least three countries, aimed at kickstarting projects for the renewal of water in small water cycles, where effective management capacity will be developed as well as technological solutions for the renewal of water in ecosystems and the effective use of public resources. The monitoring of these start-up projects will be carried out by independent civil society groups.

Jan Pokorný photo

AFRICA: Kenya, Naivasha Region--Jospat Macharia of Nabibi Farm utilizes rainwater retention to achieve food production for 80 persons even in long dry periods; water storage for irrigation of crops is provided by tanks that hold 100 cubic meters, distributed according to the needs of each plant species. Abundant vegetation has also provided wildlife habitat.

Photos courtesy of Africa Center For Holistic Management (top) and Seth Itzkan (bottom)

AFRICA: Zimbabwe- Holistic Grazing Management restores carbon and water to degraded landscape by changing the way in which livestock is grazed. ***See Chapter 7.2.2.***

7. IMPLEMENTATION OF THE GAP AS NATIONAL ACTION PLANS

To achieve combined multi-sector and economic incentives of the Global Action Plan (GAP) at the national level, we recommend an integrative approach on two levels:

(1) Implementation of the National Action Plans (NAPs) through integrated projects for permanent restoration of water in small, regional water cycles, via GAP-based watershed, or basin projects.

(2) The implementation of NAPs into economic processes of public and private business sectors via multiple economic incentives.

7.1. Integrated Reconstruction Projects to Restore Small Water Cycles

Through partnerships for basins, work will include preparation, processing and realization of integrated reconstruction projects for restoration of small water cycles in the basins, achieving funding, assuring long-term operation and maintenance of all technical measures, and managing the water and landscape works achieved, as well as buildings and other necessary additions or changes to existing infrastructure[33]. These are to be created through a declaration of the common goals of the partners in accordance with the GAP, to take responsibility for the ecological integrity of the basin.

Motivation of a basin's partnership stakeholders lies in their responsibility for permanent restoration of small water cycles, together with determining the incentives of all stakeholders for the preparation, processing and realization of an integrated Partnership Action Plan (PAP) for the river basin. Multi-sector participation in startup projects, activated with support of the World Bank, especially at the beginning stages of each PAP, will be possible only through active participation not only of governmental agencies, but also scientific and civic sectors. This may require significant changes to existing institutions that manage basins, which will lead to restructuring and more effective actions. NAP programs will thus become multi-faceted tools for permanent renewal of water in each nation, through small water cycle restoration. The PAPs will become a greater contribution of primary importance to each nation's ability to both consolidate public finances and increase the efficiency of macroeconomic management, on the road to sustainability.

7.2. Economic Benefits of the GAP For Individual Nations

Nations will achieve legislative changes for the effective dynamics and timeliness of their NAPs, as a result of feedback processes provided by the GAP; such processes will ensure the full-scale implementation of the GAP, addressing a wide variety of environments and levels of ecosystem damage, and thus increase widespread value and productiveness of landscapes. Furthermore the GAP's implementation, through NAPs, will create new opportunities for products and services, thus providing new jobs and decreasing unemployment levels nationwide.

As a result of implementation of the NAP Program in each country, rainwater will be retained in the landscape, resulting in effective preventive measures to reduce the risk of flooding and drought, and mitigate climate change; the retained water will also, in many cases, become a critically important resource for increased agricultural, urban and commercial usage; these opportunities can be further developed and promoted by governments, public institutions, and private business and civil sectors. Depending on the type of landscape in which the specific projects of the NAP will be implemented, rainwater will be retained in revitalized regions through various accessible, effective, and multifunctional methods based on renewable natural resources. The first realization is that existing natural areas, particularly wetlands must be preserved or restored, including diverse native plant, animal, fungal and

[33] Long-term operation and maintenance of functionality of all landscape works, including buildings and utilities, to reduce liabilities and risks created by corresponding integrated projects, will be an essential part, achieved by including operation and maintenance in the total cost of a project's budget.

microbial species. In landscapes heavily impacted by human activities, however, restorative interventions are needed; effective rainwater retention and benefits realized by such measures include the following:

7.2.1. In forested lands, basic measures for rainwater retention include infiltration trenches and waterbars in logging roads; simple rainwater catchments of earth, stone, and logs or brush to repair gullies; followed if necessary by replanting of harvested trees; restored forests will 1) provide a source of natural high quality drinking water[34], increasing current and future limits of economic development of large areas, both regionally and nationally; 2) increase the volume capacity of water sources, thereby increasing the energy potential of watercourses, while at the same time moderating movement of water through the landscape and thus reducing both flooding and droughts; and 3) provide far-reaching climatic benefits of forests including the cooling effect of shading afforded by the tree canopy; conversion of solar energy into latent heat[35] via transpiration, and the formation of rain clouds via the mechanism of the biotic pump[36].

7.2.2. In agricultural and rural areas, measures to increase rainwater retention include water catchments in the form of farm ponds and swales; in addition much improved agricultural methods will incorporate cover crops and no-till methods for grain, vegetable, and fruit production; holistic intensive grazing management of livestock is of particular interest for the world's pasture and natural grassland areas[37]. Such measures will 1) increase production potential of agricultural land by preventing moisture loss and subsequent degradation of the land, as well as reducing erosion and pollution, and increasing biodiversity, while providing efficient reservoirs suitable for the growing of crops and watering livestock; 2) economically strengthen agricultural activities by increasing production, as well as diversification, for example by using created farm ponds for raising aquatic flora and fauna; and 3) create an attractive environment for economic development of the countryside for agro-tourism and educational programs.

7.2.3. In urban landscapes and for road infrastructure, rainwater retention can be achieved by use of innovative practices, such as green roofs, rain gardens, vegetated swales, rainwater storage tanks, and other bio-technical systems for conserving water necessary for municipal services, such as fire fighting and road cleaning; and integration of other innovative approaches to water management, for example by sophisticated and highly effective biotechnological municipal wastewater treatment. Such measures will be an effective means to 1) achieving economically feasible measures for climate restoration, such as cooling of high temperatures induced by heat islands in intensively developed environments typically made arid through extensive impervious surfaces, 2) reducing flooding and pollution related to the rapid flushing of stormwater over impervious surfaces and via storm sewers into rivers, and 3) increasing vegetated green areas for increased aesthetic, health, and recreational value for urban dwellers, as well as opportunities for local food production.

7.2.4. Particularly in arid and desertified regions of the world, all of the aforementioned measures for rainwater retention will be of further benefit by 1) increasing water and food security; 2) strengthening social cohesion and solidarity, and reducing conflict over water rights; 3) spurring economic growth, and 4) restoring native ecosystems and biodiversity.

Through practical implementation, revitalization, and conservation of rainwater in all countries, the GAP will not only directly fulfill its main objectives — building of flood prevention measures and

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[34] Running Pure, an analytical study of the World Bank (November 2002), states that production of incomparably better quality potable spring water from forest ecosystems, is up to seven times more efficient than previously applied technologies based mainly on building large-scale water reservoirs.

[35] see Definition of Terms, Appendix

[36] http://www.hydrol-earth-syst-sci.net/11/1013/2007/hess-11-1013-2007.html

[37] http://www.planet-tech.com/blog/holistic-management-and-water-restoration

reducing climate change risks — but will also create specific secondary social and economic benefits, incentives for innovation and demand for new technological products and services, thus creating long-term opportunities for higher employment and economic growth.

Farsighted strategic thinking and targeted support of innovation, and introduction of new processes and products in the field of efficient use of recovered rainwater from restored small water cycles, presents a unique opportunity for businesses and investors to establish themselves in a sector which has prospect of dynamic growth[38] in a global context. In coming years, technology companies in this sector could create for themselves a significant competitive advantage in the global economy, at the time when knowledge, skills, technology, technical solutions, machinery and production equipment and related services of the GAP will be in high demand. Markets will grow in the economies of developed nations that already have high concentrations of intensive urban areas (Europe, USA, Canada, Japan) as well as in markets in economies with large industrialization potential (China, Russia, India, Argentina, Brazil, countries of the Balkans). Extraordinary demand for products of this sector can already be observed in the countries of the Middle East (Saudi Arabia, Israel, Turkey), North and South Africa (Algeria, Morocco, Egypt, Libya and South Africa) and Australia. The markets of all countries will provide sufficient business and investment opportunities in the mid-term as a result of their intensive urbanization and insensitive construction of industrial and transport infrastructure in the recent past.

An essential part of the GAP, therefore, will be projects that activate innovative thinking and use professional human potential emanating from universities and academic and public research institutes, in partnership with business professionals. With effective formation of productive technology teams, multi-sector contractual partnerships will increase a synergy for efficiently functioning technology as an effective tool for formation of national and international technology firms, and their successful entry in the competitive international market. Technological aspects of rainwater management (RWM)[39] will therefore create unmatchable opportunities for utilizing the creative potential of universities and research institutions in conjunction with the private industrial sector.

Especially in the case of young university students, both the GAP and NAPs will combine use of technical equipment and academic learning, through student design and development teams. Through the submission of graduate projects of the programs, opportunities will be created for effective use of the students' expertise, knowledge, and undisputed creative potential, with highest priority to be granted in those countries where youth unemployment exceeds 20%.

7.3. Human Potential and Its Activation

Human resources and use of professional potential are decisive for the success of any human endeavor. The GAP, as a temporary, challenging program with a global reach, has highly important ramifications for social behavior in these troubled times. Support of the global GAP community can not only restore rainwater to small water cycles, but may substantially contribute to recovery of global climate as well as social and environmental security in all corners of the world; the GAP provides an opportunity to create more than 100 million jobs. The GAP will therefore specifically focus, through integrated implementation, on activating human potential, such as expertise, knowledge and skills. Activation of human potential, and the correct setting of incentives in each country, will undoubtedly be one of the most important, but also the most complex, challenges of management of NAP Programs in each country.

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[38] For example ,in the US market a number of companies offering innovative products and services, particularly for the urban green infrastructure (green roofs, rain gardens, etc.) are already established.

[39] Rain Water Management (RWM) - Management of rainwater for permanent renewal of water in small water cycles, for flood prevention, and for reduction of land dehydration and other risks of global climate change.

For further elaboration and assurance of the efficient utilization of water, energy, production and commercial potential of forested, agricultural, urban land, and particularly arid regions of the world created by the program, and for the necessary activation and use of professional human potential, it is necessary, while strictly respecting the ecosystem approach of permanent recovery of water in landscape ecosystems, to create, through legislative process, legal rules for 1) a system of economic incentives for nationwide rainwater retention in all countries; 2) targeted efficient allocation of these economic incentives for investors, operators of water retention systems and manufacturers of sophisticated technologies, and innovative technical solutions for enablement of the necessary rainwater retention; and 3) a motivating and effective macroeconomic method of time allocation of the stimuli and incentives for rainwater retention, leading to a timetable of operation.

At the level of the United Nations, a resolution for permanent renewal of rainwater in small water cycles needs to be approved, and an institute of the UN High Commissioner for implementation of the GAP needs to be established. The institute of the High Commissioner will launch the implementation of the GAP intervention in communication with global and continental institutes. The dynamics of current global issues and international conflicts imply that GAP implementation at the global level will start immediately after the Climate Change summit in Paris in December 2015.

To ensure the implementation of the legislative process as specified in section 7.3, for the execution of actions, activities, and works that make up its contents, and to implement necessary legal and expert analysis, a team of professional and experts needs to be established in each country. The dynamics of the GAP require and assume that the above legislative process of economic incentives will begin in 2016 in individual countries.

Atul Pagar photo

INDIA: Darewadi project, 2012. Watershed development treatment (continuous contour trenches and tree plantings) for rainwater retention and soil conservation. The watershed treatment was completed in 2002. See Watershed Organization Trust at www.wotr.org.

8. MACRO ECONOMIC BENEFITS OF THE GLOBAL ACTION PLAN

Global recovery of small water cycles and climate change through rainwater conservation and retention in damaged ecosystems, and the overall revitalization of the landscape creates direct 1) financial and 2) overall macroeconomic benefits. The objective of the GAP is to create cyclical retention of rainwater at a volume capacity of 760 km^3 in the period from 2015 to 2025. Depending on available funding, the maximum implementation period of the program is in the range of 10 years.

The cost of a volume of 1 m^3 of conserved water under the program will be a maximum of $4 (US dollars) from public funds. The total cost of the program, to build the established cyclical water retention capacity during the period of implementation of the program, will reach approximately $3 000 000 000 000[40]. Implementation of the GAP and its economic multiplier effects will result in overall macroeconomic benefits which will, undeniably far outweigh the costs of the program.

8.1. Financial benefits of the program

The main factor that determines the high macroeconomic effectiveness of the GAP is that the program, by building the established cyclical retention capacity of rainwater with the volume of 760 km^3, creates simultaneously:

(1) effective protection against floods, droughts, and other risks on all continents, by achieving a cyclic capacity of water retention volume of 1 000 km^3;

(2) increased high-quality water resources with a total annual contribution that is equal to at least the minimum volume of built cyclical water retention capacity[41]. Based on the calculation of the yield of new water resources, this will achieve at least 30 000 m^3 per second.

Other important sources of macroeconomic benefits of the program are financial benefits from the multiplier effects of GAP.

8.1.1. Financial benefits from direct implementation of the GAP

Synergistic effects of the program from the simultaneous development of preventive measures against floods and other risks, together with the formation of new high-quality water sources, using innovation technology from the rainwater management (RWM) sector, will achieve:

(1) at least five times more efficient use of financial resources when compared to previously applied technology in the acquisition of water resources;

(2) at least ten times more efficient use of financial resources in comparison with the building of large-capacity water reservoirs for the acquisition of new water sources. Taking into account the social costs of acquiring new water sources, the program retrieves ten times more water resources than current methods of investment in water management.

8.1.2. Financial benefits of multiplier effects of the GAP

The strongest side of the program lies in the creation of multiplier economic effects, of which detailed

[40] The numeric representation of the macro-economic benefits and costs of GAP listed in this section are based on cautious, conservative techni cal and economic calculations obtained in Slovakia in 2010-11. The values are not time discounted. Detailed calculations of macroeconomic efficiency will be an indispensable part of any NAP at national level.

[41] Technical calculation, based on a minimum level of efficiency of the transformation of the volume of retained water to built volume of water source, is made on the basis of projects that were actually implemented, while the achieved efficiency of water retention system of programs for creating water sources will be carefully evaluated in comprehensive specific program projects.

specifications are given in Section 7.2, and in macroeconomic benefits which consist primarily of permanent creation of new jobs and tax revenues from sales generated by the technology sector RWM, and by other economic activities created by the GAP. Even in the first stages of its implementation, the program will immediately create jobs, especially for the long-term unemployed. It will also generate employment opportunities for less-skilled workers who are suited to physical labor, in forestry and agricultural activities in rural landscapes.

Depending on the scope and dynamics of implementation, the GAP will allow creation of up to 100 million jobs during the intensive implementation period (2016-2025). Jobs will include working in the area of building landscape structures for water conservation, technical solutions for rainwater conservation, and establishment of a system for increasing the retention capacity of damaged ecosystems. The employed will work directly in the damaged sections of each country.

Following the establishment of rainwater conservation systems, maintenance of systems necessary in order for them to maintain their functionality will create a minimum of 15 million permanent jobs. Furthermore, large major employers may gradually evolve into technological, production, trade and service companies in the RWM sector, due to increasing momentum from comprehensive implementation of the GAP. The program will thus create business opportunities as well as jobs for professionals, highly skilled workers and innovative managers. The introduction of new technologies will provide opportunities for their implementation and operation, as well as the subsequent provision of related services. A total estimated 12 million new, permanent job opportunities will be created.

The GAP will jumpstart the restoration of agricultural areas of countries and regions that have lost their productive potential. We estimate that over the course of ten years soil fertility will be increased on more than 5 million km^2, which will have a major impact on global food security; this will in turn create more than 100 million jobs in the poorest regions of the world. At the same time, food supplies will be increased for more than 500 million people who currently suffer from hunger. The realization of the GAP would also decrease water shortages for more than 1 000 000 000 people.

Through the GAP, major revitalization of withered countries through forest regeneration will occur. Reconstructed countries also will valorize in a way so that less developed countries that are poor in terms of food, water and economy can be on the path towards sustainable prosperity. The macroeconomic benefits of the GAP go beyond monetary values. Current civilization has little experience with what macroeconomic benefits, for example, the restoration of soil fertility can bring; therefore it will be tested on pilot projects as defined in the chapter 5.2.

At the time of dynamic growth and permanent establishment of technology companies in different market segments, the RWM technology sector and other economic activities created by the program will generate tax revenues arising from their sales in addition to the macroeconomic benefits from increases in job opportunities.

Assuming a total return of RWM sector during the period of middle life sector, a scale equivalent to 2.5 times the cost of the program, the aggregate tax revenues of the RWM sector will achieve minimum amount of $2 000 000 000 000.

8.1.3. Total financial evaluation of macroeconomic efficiency

As follows from the economic calculations mentioned in the previous sections, the overall macroeconomic financial benefits of the program safely cover the total cost of the GAP in the period of a maximum of 10 years commencing with the creation of specified cyclical water retention capacity. Furthermore, it is also clear that the implementation of the program, in the long-term, creates a global macroeconomic effect of at least $10 000 000 000 000. This amount represents savings of global funds that would be needed to address the solutions for water supplies through traditional technology.

Through traditional methods and technologies, it is not possible to reach an equivalent level of technical efficiency and effectiveness of macroeconomic systems, water conservation, innovative technology and other technical solutions for the rehabilitation of water in small water cycles, that is possible by utilizing the GAP.

8.2. Overall Benefits of the Global Action Plan

The world has one strategically valuable natural resource: water, and one talented, but yet under realized, intangible resource: human potential. The GAP opens up opportunities for the optimization of human potential through new technologies and new products and services. It creates opportunities for efficient, yet environmentally sensitive and cautious usage of this blue planet's potential, and the start of restoration of damaged landscapes by the realized return of water to small water cycles.

The economic potential of all the earth's resources can be multiplied by the synergy that is created and supported through creation of the GAP, through its strategies based on the processes of the natural world combined with human potential. The opportunities for innovation in the rainwater management sector will generate a desirable and creative economic growth and a significant contribution to long-term solutions to global problems, including desertified and degraded lands, lack of clean water, and the resultant poverty and civil unrest.

The total contribution of the GAP could in fact be incalculably higher, by creating environments worldwide in which it will be possible to safely work, operate a business, and enjoy a good quality of life. Benefits which statisticians do not currently include in GDP growth figures, will include massive relief from water stress and a major increase of financial investment by those who recognize the vast opportunities for new business.

Thus a global economy based on local renewal of water cycles provided by the GAP will create conditions for improving the quality of life, even in the parts of the world where there is presently a dire lack of water and food. Vast areas of previously arable land have become dry and barren through humanity's mismanagement of rainwater over the past decades and even centuries. Restoring these lands, by recapturing rainwater into the earth and local small water cycles, will inexpensively ease the great burdens of everyday life suffered by the majority of the world's population. The GAP will provide abundant water resources to support not only the vast biodiversity of healthy ecosystems but also increased human populations. Women, however, who are freed from the burden of sheer daily survival will likely become better educated and pursue livelihoods beyond bearing children, which would lead to decreased birthrates and increased education for their children, creating an upward spiral out of poverty.

Lacking water, very little improvement of ecological degradation, poverty and strife is possible; with water, everything is possible. The Global Action Plan can lead the way to water security for all, and renewed hope for much increased peace and prosperity, for a revitalized world emerging from restored lands and climates. Thus we invite all stakeholders, citizens of all nations, of all walks of life public or private, to join in a cooperative effort to help restore life-giving small water cycles to Planet Earth.

Definition of terms used in the Global Action Plan (GAP)

Biotic pump - a theory emphasizing the role of forests in climate. Due to the high leaf area index, natural forests maintain high evaporation fluxes, which support the ascending air motion over the forest and "suck in" moist air from the ocean, which is at the heart of the biotic pump theory of atmospheric moisture.

Heat islands - land areas (usually urban) that are significantly warmer than surrounding rural areas due to human development, such as paved surfaces, rooftops, and removal of vegetative soil cover.

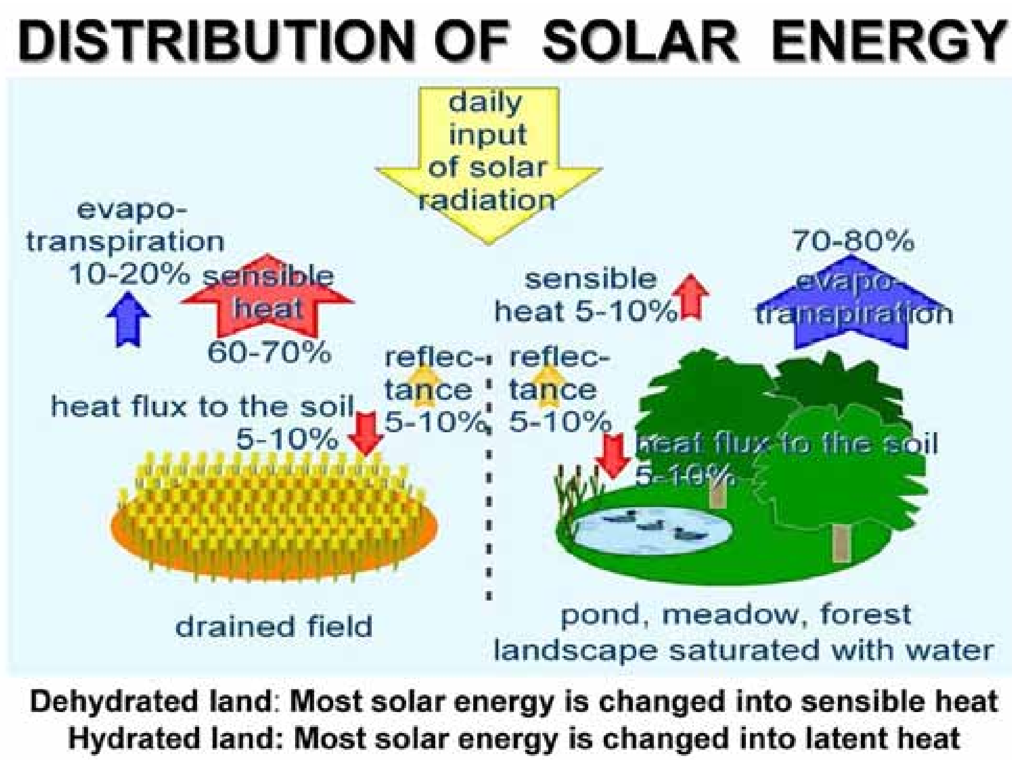
Latent heat - the heat required to convert a solid into a liquid or vapor, without causing a change of temperature.

Sensible heat - heat exchanged by a body or thermodynamic system that changes the temperature, and some macroscopic variables of the body, but leaves unchanged certain other macroscopic variables, such as volume or pressure.

Mountain massif - A large mountain mass or compact group of connected mountains forming an independent portion of a range. A massif often consists of rocks that are more rigid than the surrounding rocks.

Small water cycle - a closed circulation of water in which water evaporated on land falls in the form of precipitation over this same terrestrial environment. Small water cycles also occur over seas and oceans[42]. As opposed to the **large water cycle**, which is the exchange of water between ocean and land[43].

Transpiration - the evaporative process by which moisture is carried through plants from roots to leaves, where it changes to vapor and is released to the atmosphere.



[42] New Water Paradigm - Water for the Recovery of the Climate, Municipalia, 2007, www.waterparadigm.org, p 17
[43] New Water Paradigm - Water for the Recovery of the Climate, Municipalia, 2007, www.waterparadigm.org, p 16