Sustainable Aggregates Resource Management: experience learnt and shared within South East Europe

Trajnostno gospodarjenje z mineralnimi surovinami za gradbeništvo – izkušnje, pridobljene v jugovzhodni Evropi

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Abstract: The purpose of this paper is to describe sustainable mineral resources management and its application to aggregates management. First the theoretical foundations of sustainable resource management are introduced in the context of the characteristics of aggregates that differentiate them from most other mineral commodities. The environmental, economic and social aspects are reviewed and well as the challenges of implementation and the necessity of adaptation. The remainder of the paper discusses the SARMa project, which implemented sustainable aggregates resource management (SARM) and sustainable supply mix (SSM) in South East Europe (SEE). SARMa had 14 partners in 10 nations who worked together to develop a common approach to SARM and SSM in SEE. The project produced 3 manuals addressing such issues as environmentally friendly quarrying, decision-making for SARM and SSM at the regional, national, and transnational scales, and construction and demolition waste management. These results built on numerous case studies, analyses and recommendations that led to common

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methods and knowledge management tools. SARMa contributed to the SEE Programme's overall objectives by integrating environmental, social, and economic aspects of sustainability with respect to aggregates, capacity building, and fostering transnational territorial cooperation.

Izvleček: Namen članka je predstaviti trajnostno gospodarjenje z mineralnimi surovinami s poudarkom na gospodarjenju s kamenimi agregati. V prvem delu so predstavljene teoretične osnove trajnostnega gospodarjenja z viri glede na značilnosti kamenih agregatov, ki se razlikujejo od večine drugih mineralnih surovin. Prdstavljeni so tako okoljski, ekonomski in družbeni vidiki, kot tudi izzivi izvajanja trajnostnega gospodarjenja in potrebe po prilagajanju sprejetih politik. V drugem delu članka je predstavljen projekt SARMa, ki je apliciral koncepta trajnostnega upravljanja z mineralnimi surovinami (SARM – Sustainable Aggregates Resource Management) in trajnostne oskrbe (SSM – Sustainable Supply Mix) v jugovzhodni Evropi (JVE). Pri projektu je sodelovalo 14 organizacij iz 10 držav, ki so razvile skupen način obravnave SARM in SSM v JVE. Nastali so trije priročniki, ki obravnavajo teme, kot so: preprečevanje ali zmanjševanje površinskega pridobivanja na okolje, sprejemanje odločitev o SARM in SSM na regionalni, nacionalni in mednarodni ravni ter pridobivanje recikliranih kamenih agregatov iz inertnih odpadkov. Nastali rezultati temeljijo na številnih študijah primerov, analizah in priporočilih, ki so vodili k skupnim metodam in orodjem za povečanje znanja vključenih ciljnih skupin. Projekt SARMa je prispeval k ciljem programa Jugovzhodna Evropa, saj je povezal okoljski, ekonomski in družbeni vidik trajnosti na področju kamenih agregatov, pripomogel k izboljšanju kapacitet ter spodbudil mednarodno teritorialno sodelovanje.

Key words: Mineral resource management, Sustainable development, Policy, Sustainable supply mix, Slovenia

Ključne besede: trajnostno gospodarjenje z mineralnimi surovinami za gradbeništvo, trajnostni razvoj, politike, trajnostna oskrba, Slovenija

Introduction

In the second half of the twentieth century, societies began to realize that new approaches to development were needed. Human activities were having impacts that exceeded the Earth's carrying capacity on global, and in many places on regional and local, scales. This was particularly true with regard to environmental pollution and the consequences of natural resource extraction and consumption. Minerals are resources that are both essential for modern existence and future development, and whose extraction, use and disposal can cause negative social and environmental impacts. Societies cannot be expected to forego the stream of benefits coming from the use of mineral resource products, and by extension from mining. Therefore, it is crucial to encourage both the mitigation of cumulative negative impacts, which were in most cases the consequences of past practices, and the implementation of new, better practices.

Recognizing that past activities are no longer acceptable, a new development framework has emerged. The framework, called sustainable development, has four overarching goals: economic prosperity, environmental health, social equity for the present generation, and equal opportunities for future generations. In the past decade, the goals of sustainable development have been embraced by most countries in the world, and are now being applied to decision making at global, local, and individual scales, including those decisions related to mining.

The foundations for sustainable mineral resource management were laid through a review of sustainable development concepts, their links to mineral resources, national mineral policies and management programs. The likelihood of improved choices from among possible development options is increased when those decisions are informed by knowledge and science. Scientific and technical expertise can be applied to monitoring socio-economic and biophysical processes and, in so doing, provide information and data to every stage of the policy cycle, including to sustainability policies.

Earth scientists, geologists and others are involved not only in fundamental research projects, but also in applied projects. Most applied projects are multidisciplinary and have as their goal the solution of different open and ongoing challenges that society faces. An important set of these projects deals with the provision of an adequate and secure supply of raw materials. This paper describes a Southeast Europe project "Sustainable Aggregates Resource Management". The main objectives of the project are to develop a common approach to sustainable aggregate re-

source management (SARM) and sustainable supply mix (SSM) planning at three scales (local, regional/national, transnational) to ensure efficient and secure supply in South East Europe.

Sustainable aggregates resource management

There has been an inappropriate tendency to focus exclusively on metals when minerals are used as an engine of development. As a result, the potential positive contributions of mineral development are often overlooked in countries with limited endowment of metals.

Under- or over-emphasis on the minerals sector can be lessened by addressing mineral development within the context of sustainable development. Each country identifies sustainability goals, with respect to social equity, environmental health, and economic growth that are appropriate to its circumstances. The contribution of mineral resources to the achievement of those goals will be similarly context dependent.

Natural aggregate is an essential commodity in modern society. Developing nations need stable, adequate and secure supplies of construction materials to build the infrastructure needed to achieve the Millennium Development Goals (Baird & Shetty, 2003). This includes highways, roads, bridges, railroads, airports, seaports, water and waste treatment facilities, and energy generation facilities. Construction materials are also essential to the provision of sustainable housing and the expansion of industrial capacity (CIB & UNEP, 2002). These large volume materials will need to be provided in a rational integrated manner that maximizes their societal contributions and minimizes environmental impacts.

Natural aggregate is a material composed of rock fragments, which may be used in their natural state or after mechanical processing such as crushing, washing, and sizing (Langer & Tucker, 2003). There are two categories of aggregates, gravel and crushed stone. Gravel generally is considered to be material whose particles are about 2.0 mm to 63.0 mm in diameter. Its edges tend to be rounded. Crushed stone is of the same size range, but is artificially crushed rock, boulders, or large cobbles. Most or all of the surfaces of crushed stone are produced by the act of crushing, and the edges tend to be sharp and angular. Natural aggregate has hundreds of uses, from chicken grit to the granules on roofing shingles (tiles). However, most aggregate is used in cement concrete, asphalt, and for other construction purposes. The average per capita consumption of aggregate generally ranges from 5 t to 15 t per year (Langer & Šolar, 2002).

While aggregate is a non-renewable resource, supplies are nearly inexhaustible on a global scale. They have characteristics that differentiate them from most other mineral commodities:

- a high number of potential extraction sites;
- a high volume to value ratio;
- significantly different set of potential environmental impacts; and
- regional importance combined with a narrow economic transportation radius.

In most cases, aggregate demand is met by local or in-country suppliers. This occurs because most aggregate transportation is carried out on roads and transportation short distances to different locations by road is economically viable. Moreover, constructing and maintaining a dense road network is less expensive than constructing rail or channel networks.

In many countries, aggregates have simplified legal frameworks (local level competence, licensing, taxation, control) compared to other minerals due to the above mentioned characteristics. In some countries aggregates are the landowner's property even if most of other minerals are state owned.

Aggregates are very often overlooked in minerals sustainability debates due to the fact that they are seldom export products of national importance like metals or energy resources.

Aggregates typically do become part of sustainability debate in countries with organized environmental protection groups that have active individual members. These are mostly developed countries where mining is a declining economic activity and most other types of mineral extraction have ended. In developing countries, the negative and positive effects of quarrying are not important issues in the development debate because the negative impacts of aggregate extraction that are passed on as burdens for future generations cannot be compared with the present desire for faster economic development and poverty alleviation. The fact that the costs of remediating negative social and environmental impacts of aggregate quarrying and use will be higher in the future than they are today is neither a priority nor a point of discussion in most developing countries.

Nonetheless, aggregates should be an integral part of any country's overall sustainability plans. Geological settings, and economic and social conditions, are influential factors in determining how aggregates are supplied. But because the manner in which aggregates are supplied affects the ability of developing nations to achieve a sustainable future, it is important that a country's strategic and operational

policy guidelines are based on sustainable development principles.

Construction materials and aggregates present a very clear example of the transition from natural to human-made (manufactured / physical) capital. In order to optimize this transition, the positive impacts of quarrying should be maximized and negative ones minimized.

Lack of understanding about the links among different types of impacts of quarrying is a source of time consuming disagreements between stakeholder groups, including the general public, industry, environmental, social and expert groups on local and national levels. One of the most effective ways to identify the full range of positive and negative impacts, as well as system interactions, is to examine the entire quarry and product life cycle. Societal, value based, objectives expressed in policies emphasize certain parts of life cycle and bring those issues to the attention of stakeholders. One of the tools that can be used to ensure that mineral resources (aggregates) are provided in a manner that contributes to sustainability over the full life cycle is Sustainable Aggregate Resource Management (SARM).

Environmental Aspects – SARM requires developing aggregate resources in an environmentally responsible manner that does not result in long-term environmental harm, even if short-term environmental impacts are unavoidable. Two main environmental categories should be considered in SARM: reducing negative environmental impacts and resource protection / conservation. These goals are very achievable because the aggregate industry has made, and continues to make, great strides in environmental management.

Most destructive environmental impacts of aggregates are on the landscape (visual intrusions), air (noise, dust), water (surface, underground water), soil (erosion, pollution), and on biota (loss of biodiversity). Besides type, the nature of impacts (range, timing, duration, ability to prevent /control) should also be considered (Langer & Arbogast, 2002). There are many regulatory and voluntary tools that can be used to identify, reduce and control negative environmental impacts. These include environmental impact assessment, environmental management systems, environmental accounting, environmental reporting, life cycle analysis, ISO 14000 standards, all of which can be applied both on-site (quarry & processing facility) and to transportation routes.

SARM, however, is not just about protecting the environment from the potential negative impacts of aggregate

extraction. Reclaiming aggregate operations or orphaned sites has tremendous potential to improve our quality of life, create additional wealth, increase biodiversity, and restore the environment. In the expanding suburban areas of today, mined-out aggregate pits and quarries are converted into second uses that range from home sites to wildlife refuges, from golf courses to watercourses, and from botanical gardens to natural wetlands. Reclamation should be a major consideration in sustaining the environment and in creating biodiversity (Langer, 2003).

Mineral resource (aggregate) protection includes: (a) minimal exploitation of primary aggregates with rational production by introducing the recycling and reuse of construction materials as secondary aggregates; (b) exploitation of renewable aggregate and substitute resources; (c) increasing the knowledge about aggregate potential, and (d) preserving the land access to aggregates in designated areas. The first two of these protection measures are intended to reduce the demand for aggregate that is newly mined or from newly developed sites. The latter two address the long-term need for primary materials (Šolar, 2003).

Economic aspects of SARM – There are four main economic aspects to SARM: (a) ensuring that the material requirements of society are provided for; (b) maintaining a viable business environment; (c) encouraging value-added production and employment; and (d) embracing full cost accounting while remaining competitive. The first three of these are the responsibility of government. The fourth is the responsibility of the firm.

All societies utilize a stream of material inputs for manufacturing and construction. In the case of transition and post-conflict economies, there is particular need for construction materials to support development and rebuilding of infrastructure, industrial capacity, and housing. One aspect of SARM involves ensuring that these resources are available to the marketplace. This is sometimes referred to as secure supply. The main elements of secure supply are creation or maintenance of production capacity, identification of sufficient reserves and resources, provision of land access (extraction and exploration sites / areas), and development of the country's or region's infrastructure capacity (roads, railroads, power). All the foregoing issues are interlinked and need to be balanced by policy makers and resource managers. Secure supply can also take the form of importation in cases where the full cost of domestic supply would be higher than the full cost of imported materials.

A viable business environment exhibits the following characteristics: (a) a sta-

ble and feasible permitting regime; (b) consistent application of rules and regulations; (c) functioning capital markets; (d) reasonable levels of taxation; and (e) well defined property rights. Underemployment and unemployment are serious problems in many parts of the world. Therefore, governments should also consider setting policies that support the availability of a trained workforce and promote employment in the extractive industries. Development of value-added manufacturing is another important issue. Existence of a value-added sector can reduce the need for imported materials while allowing the domestic economy to capture the economic benefits (employment, tax revenues) that would otherwise accrue in another country.

Economic realities drive industry activity. Firms need to remain competitive if they are to stay in business. Nonetheless, firms have a responsibility to accept the full cost of doing business, including costs of preventing or remediating environmental damage. Industry must be willing to accept the fact that in some cases, when all the costs are taken into consideration, a quarry will not be a viable economic enterprise and must be either shut down or not developed. Firms can, however, increase competitiveness by modifying production processes, upgrading product quality, and maintaining a well trained workforce. Production process and product quality can be achieved through voluntary quality control procedures such as adherence to ISO 9000 requirements. Quality is an important market element that can be labeled and traded. Research and development (R&D) is another issue that increases the enterprise's overall performance and has a great impact on increasing the added value.

Some of R&D's goals include new products, and using BAT (best available technology) in the field. Finally, maintaining or increasing employment is not only governmental issue, because human resources are one of most important driving forces of every enterprise. Corporate culture, knowledge and skills need to be created, maintained, reviewed and revised (if necessary). Special attention with regard to human resources should be put on health and safety of employees.

Social aspects – Identifying stakeholders' values, interests, goals and the scale at which they apply is the first step in resolving the complex situations that impact a country's ability to maintain a secure material supply and achieve other policy goals. As an example, there may be abundant sites in a region that have suitable aggregate, but the existence of conflicting land uses, zoning, regulations, or citizen opposition can lead to insufficient or more costly supply. Scale of interest is a con-

sideration in such situations due to fact that benefits and costs accrue to different parties in different regions. A third important issue is intra-generational equity, fairness to those living near or impacted by quarrying. Equity implies a need for transparency and public participation in decision making, as well as access to information within democratic process (Šolar, 2003).

Broader societal aspects can be described in terms of the legal framework, communication and education. The legal framework should protect the interests not only of country or region, but also investors and all other stakeholders. An effective legal framework needs balance between administrative requirements and flexible, time efficient, inexpensive procedures of licensing. Further, a country or region needs to have the institutional capacity to implement and enforce the legislation (monitoring and control components in particular), to develop and maintain resource information infrastructure, to foster research and development, to use funds from mineral rents (taxes) for the benefit of current and future generations, and facilitate cooperation with other sectors.

In addition to the legal framework, voluntary initiatives from different stakeholders (industry, non-governmental organizations) enrich dialogue and facilitate agreements. Voluntary initiatives include communication, education, partnership, and participation. All stakeholders should have access because increased awareness of the costs and benefits of supplying materials to society will lead to more timely agreements about how to (re)distribute costs and benefits of aggregate extraction and use. (Šolar, 2003).

Implementation – To ensure that aggregate resources are managed in a sustainable manner, each of the primary stakeholders – government, industry, public, and other non-governmental organizations – must accept certain responsibilities. The government is responsible for developing the policies and climate that provide conditions for success. The industry must work to be recognized as a responsible corporate and environmental member of the community. The public and non-governmental organizations have the responsibility to become informed about natural resource management issues, take personal responsibility for their consumption patterns, and to constructively contribute to a process that addresses not only their own, but a range of objectives and interests. All stakeholders have the responsibility to identify and resolve legitimate concerns, and the government, industry, and the public must cooperate at the regional and local levels in planning for sustainable aggregate extraction (Langer, 2003a).

To be effective, SARM must be a pragmatic pursuit, not an ideological exercise. It is an iterative process and government, citizens, and industry should all be involved in the pursuit. The process consists of a number of steps, including issuance of policy statements, elaboration of objectives, establishment of actions, identification of indicators, and monitoring:

- Policy statements issued by governments commonly identify the aggregate industry as a key industry contributing to jobs, wealth, and a high quality of life for their citizens, and commit the government to the protection of critical resources and protection of citizens from the unwanted impacts from aggregate extraction. Industry policy statements commonly identify environmental and societal concerns and commit the company to environmental stewardship and interaction with the community.
- Objectives describe what is to be accomplished and commonly are subsets of the social, economic and environmental components of SARM. Typically objectives will include, but not be limited to: (a) ensuring future supplies of aggregate; (b) reducing the demand for newly mined aggregate; and (c) protecting and restoring the environment.
- Actions are associated with each objective and describe the steps to reach the objective.
- Indicators deserve special mention. They measure progress as well as the effects of efforts to protect and enhance natural and human systems and will be discussed in more detail below.
- Monitoring, feedback, and the regular reconsideration of requirements as events develop to the SARM process. The establishment of a joint monitoring process presents an excellent opportunity to forge partnerships with communities and involve citizen groups.

Measurement – Progress toward the policy goals that have been described in detail within a resource management plan need to be measured over time. Measurement can be described in terms of the hierarchical model of principles, criteria, and indicators.

Adaptation – It is useful to think of policy making as a continuous process. Sustainable aggregate management has a place in all these stages. Over time societal goals, governmental policy, laws and acts, public and corporate management plans, regulatory regimes, and data sets can change. SARM should be seen as an adaptive process that responds to changes in social, economic and environmental system and to changing public preferences as well.

There are a range of potential problems associated with adoption, including: (a) unrealistically high expectations, (b) lack of commitment, and (c) inappropriate past practices. Therefore, a very clear roadmap of the management plan, and also a plan to address disappointment, is needed. In order to strengthen stakeholder commitment, all open issues should be discussed in a way that promotes consensus on the outcomes. Building trust and confidence during the process of creating a management plan can help overcome the distrust that has been created by past bad practices.

Given the impacts of the global recession, current aggregates production levels are now dependent to some degree on economic stimulus expenditures and on public infrastructure projects. This circumstance provides an opportunity for governments to encourage producers to practice SARM and also to coordinate their mineral policies with other public policies so as to minimize conflicts and costs and optimize benefits. Recognition of the need for SARM that fulfills present demand and planning for supplies to meet future demand is present within modern society, although stringent SARM policies do not exist in most countries. Nonetheless, the multiple aspects and goals of SARM are not being achieved in many regions or countries, including the region of South East Europe (SEE). SEE countries are rich in aggregates, but neither management nor supply is coordinated within or across the area. At the site level, the issues are high environmental impacts, a need for stakeholder consultation and capacity, a lack of social license to operate, and limited recycling. At the regional/national level, the issues are policies and regulations affecting aggregates that: do not address resource and energy efficiency or EU guidelines, preclude the use of recycled materials and industrial by-products, and fail to address aggregate consumption in long-term sustainable development and spatial planning. The transnational issues are lack of capacity and lack of coordination on aggregates production and transport. Taken together these issues demonstrate the need to shift to sustainable aggregate resource management (SARM) and sustainable supply mix (SSM) policies. As noted above, efficient, low socio-environmental impact quarrying and waste management is SARM. A SSM comprises materials from multiple sources, including recycled wastes and industrial by-products (slag), that together maximize net benefits of aggregate supply across generations.

SARMa PROJECT 2009–2011

In 2009, the EU Commission approved a project titled "Sustainable Aggregates Resource Management"

(SEE/A/151/2.4/X – SARMa) under the South East Europe Transnational Cooperation Programme. The SARMa project focused on implementing sustainable aggregates resource management (SARM) across SEE and identifying the components of a sustainable supply mix (SSM) of aggregates for SEE. It should be noted that the South East Europe Programme does not fund research, but rather is a framework intended to foster transnational partnerships and enhance the integration of new and candidate countries into the European Union through the application and distribution of existing knowledge.

Partnership – In selecting the project team, there was a need for: (a) broad geographical coverage, and (b) the inclusion of partners from old member states, new member states, and candidate countries. This assured knowledge transfer and best practices transmission to zones with less experience in SARM and SSM, which will enable better cohesion of SEE countries in aggregates management and supply. Other aspects of the partnership were: (c) competence and expertise of partners, not only in resources, but also with environmental issues, (d) vertical coverage in different countries of activities at different scales (i.e., different zones for field work, model development, and pilot implementation), which facilitated transnational activities, and knowledge transfer from experts to stakeholders at the policy and implementation levels in different countries, and (e) continuing partnership among project members and observers representing ministries in charge of mining, regional authorities, chambers of commerce, and industry. The 14 partners in 10 countries of SEE area are listed below:

1. Geological Survey of Slovenia, SI
2. University of Leoben, AT
3. Ministry of Economy, Labour, and Entrepreneurship, Directorate for Mining, HR
4. Prefectural Authority of Pella, GR
5. Institute of Geology and Mineral Exploration, GR
6. Technical University of Crete, GR
7. Hungarian Office for Mining and Geology, HU
8. Emilia-Romagna Region - Environment, Soil and Coast Defense Department, IT
9. Parma Province, IT
10. National Institute for Research-Development in domain of Geology, Geophysics, Geochemistry and Remote Sensing, RO
11. University of Bucharest, Faculty of Geology and Geophysics, RO
12. Ministry of Economy Herzegbosnian Canton, BH
13. University of Belgrade, Faculty of Mining and Geology, SR
14. Ministry of Economy, Trade and Energy, AL

Scientists and experts formed a major part of the project team of the SARMa SEE project. They were selected to ensure that the necessary expertise would be available to achieve the expected objectives and implement the expected results. Geological surveys, institutes and faculties work regularly as experts and policy advisers with government and industry and combine up-to-date knowledge and expertise in the area of aggregates. All have continuing, long-term relationships with decision making bodies in their countries and prepare strategic documents for authorities. Partners have the experience in major projects and public awareness-raising activities in order to manage the SARMa project and disseminate outputs and results. Also, 8 decision making bodies were included that have aggregates sector extraction areas under their rule and expressed a desire to participate actively in seeking solutions to the challenges of aggregates production and supply. In addition, emphasis was being placed on public/stakeholder capacity building activities (Šolar & Shields, 2011).

Project goals – The two main project objectives were to: develop a common approach to SARM across SEE, and ensure a SSM in SEE based on fair distribution of costs and benefits of aggregate production, use, waste disposal and recycling, so as to enhance resource and energy efficiency and quality of life. Other supporting objectives included: coordination in managing aggregate resources, increasing the transfer of know-how, and supporting capacity building in firms, government and civil society; development of a unified information infrastructure and common understanding of aggregates based on EU guidelines and directives, including those on protected areas, potential secondary supply, and transnational transportation networks; and prepare for a Regional Centre on SARM & SSM.

Project activities were intended to connect institutional actors, decision makers, policy implementers, economic sector, quarry operators, civil society, and NGOs through data collection activities, workshops, and targeted results at 3 spatial scales because, as previously noted issues differ by scale. Each scale was handled as a separate Work Package having its own specific goals: those being Local, Regional/National, and Transnational. Local goals: (a) optimize the efficiency of primary aggregates production, (b) prevent or minimize environmental impacts of quarrying and improve reclamation, (c) minimize illegal quarrying by improving knowledge, (d) promote recycling (construction, demolition & quarry waste), and (e) increase interested and affected groups' capacity. Regional/national goals: (a) assess and quantify aggre-

gate resources and relevant transportation links, (b) develop strategies for sustainably managing aggregate resources, including in protected areas, considering aggregate resources in land management and use planning, and harmonizing policies across regions, and (c) develop guidelines and procedures for SSM planning. Transnational goals: (a) recommend methods for harmonizing SARM & SMM transregionally and transnationally, and (b) design a multi-purpose and multi-scale Aggregates Intelligence System (AIS) as a long-term tool for know-how transfer. Planning has also begun for a Regional Centre on SARM & SSM, the purpose of which will be to increase capacity of all interested and affected groups through additional studies, workshops, and educational materials.

Final results – The Sustainable Aggregates Resource Management (SARMa) project contributed a transnational bottom-up approach by developing a common approach to Sustainable Aggregates Resource Management (SARM) and ensuring a Sustainable Supply Mix (SSM) in 10 participating SEE countries.

At the local level, the main findings for local authorities, industry representatives and communities are presented in the manual "How to achieve aggregates resource efficiency in local communities", emphasizing environmentally friendly quarrying, reduction of illegal extraction, and increased recycling.

At the regional, national and transnational level, the recommendations are presented in the manual "SARM and SSM at the Regional, National and Transnational Level", which is targeted at decision-making authorities. An additional contribution on the pathway to a more sustainable society was the "Construction and Demolition Waste Management Manual", which illustrates activities related to inert waste recycling.

As the base of these manuals (in the bottom-up approach) 50 case study reports, 10 studies/analyses, 9 different recommendations and other documents were prepared as the supporting materials. Additionally (not planned in the AF), the two specific manuals were prepared: "Guidelines for the environmental recovery of quarries in near river areas" and "Concise planning manual for the recovery of aggregate quarries". The following results should also be emphasized:

- 9 common guidelines covering recommendations for environmentally friendly quarrying, recycling and preventing illegal quarrying for industry and authorities; on implementation of (EU) legislation; for aggregate policy and management; and for development and land use

planners; on transnational level for decision-makers on SARM and on SSM;
- common methodologies adopted among partners on database framework on illegal quarrying and Life-cycle Assessment scheme, and on GIS and Aggregate Intelligence System (AIS);
- advanced tools adopted to improve knowledge management within the partnership: SARM, SSM and GIS.

Over 9 500 copies of the manuals were printed in 11 languages to facilitate dissemination to the end-users. Moreover, the messages were directly promoted to more than 1 300 representatives of public authorities and 2 100 representatives of the industry, at the 19 different regional, national or transnational workshops, aiming at increasing awareness, knowledge and capacity of the target groups. Additionally the project was presented at a number of events (over 20) organized outside the project, in SEE and EU. Thirteen press conferences were organized and 54 articles were published. Counting magazine and journal articles, over 900 000 people were reached.

On the basis of these methodologies, regional or national policies on SARM and SSM were improved in 11 participating countries or regions: Slovenia, Austria, Greece, Region of Central Macedonia, Hungary, Emilia-Romagna Region, Parma Province, Romania, Herzeg-Bosnian Canton, Serbia, Albania and Croatia. The benefits of the harmonised transnational approach are confirmed and will contribute to increased aggregates resource efficiency in participating countries. The 23 participating partners and observers intensively promoted the project outcomes to target groups in their territories.

At the policy level, important achievements have been accomplished at the national, regional and local level of 10 participating countries by contributing to the improved policies on aggregates management and supply, as well as the waste management, recycling and protection of the environment related to quarrying activities. The outcomes of the recommendations in the SEE area were also contributing to the EU policies and initiative related to these topics. Please see next point for details.

At the policy level, an important contribution was imposed in 12 participating territories (Zelič, 2012):
- At the national level:
  - Greece: the SARMa project is referenced twice in the working document for the New Greek National Minerals Policy – it was also referenced several time in the public forum presenting the work on the Greek National Minerals Policy;
  - Austria: contribution to Austri-

an Mineral Resources Plan development;
- Hungary: the transposition of the Community law and policy was impacted by the SARMa outcome on the national level, its conclusions are built into the national mineral strategy in preparation;
- Slovenia: SARMa activities coincided with the drafting of National Mining Strategy and evaluation of Mining Act;
- Romania: Mineral resources Department at the Ministry of Economy, Commerce and Business Environment of Romania has realized the need of drawing up a national mineral policy (inclusively aggregates) based (also) on promotion of SARMa outcomes and is trying to obtain financing for this project;
- Albania: SARMa Project has been implemented within the same period in which the reviewing and the improvement of the Albanian Law on Mining have been carried out as well as its approval.
- Serbia: SARMa activities had an impact on the national policies and regulations – there were some changes in the structure of Ministries related to aggregates production, new Law on Mining and Geological Exploration (end 2011), and the new Minerals Policy of Serbia is being prepared.
- Croatia: SARMa activities are positively influencing the national policy on aggregates management.

- At the regional level:
  - Emilia-Romagna Region: SARMa recommendations will be integrated into the new law on soil defence and quarrying activities, at time of writing in an early phase of development.
  - Herzeg-Bosnian Canton: public authorities in this and other Bosnian structures increased awareness, knowledge and capacity about the aggregates policy and its reference with other areas, which will influence their decision-making in the future.
- At the local level:
  - Parma Province: will apply new law about soil defence and quarrying activities that will be issued by the ER Region in the future on the basis of SARM practices and recommendations;
  - Pella Prefecture/Region of Central Macedonia: SARMa activities positively influenced the local policy on aggregates management.

The 3 dimensions of sustainability were realised in the following way, including the steps after the project end:
- Institutional sustainability is as-

sured since partners incorporated the recommendations and new methods in their daily work, at the level of public authorities or expert organisations;

- Additionally, partners are taking a lot of effort to promote and disseminate the project outputs (manuals) and the described methods also in their networks in each country or region;
- The political sustainability was is parallel assured since the recommendations addressed directly the local, regional and national policies and were promoted at the level of public authorities directly or by the expert organisations providing the expert support for these institutions;
- The financial sustainability was partially assured by financing the regular operations of the mentioned organisations in which the developed approaches will be used;
- Additionally, it was estimated that the developed recommendations are generally applicable, while especially the public authorities are still lacking capacity to incorporate them in the new or improved regulations. Therefore a new SEE project proposal SNAP-SEE – Sustainable aggregates supply in SEE was applied at the SEE programme 4th call;
- There are initiatives also for upgrading the developed topics at other levels, e.g. at the EU level in the Interreg IVc or at more scientific level in FP7, or the successors of these programmes.

The project had a significant impact on territorial cohesion of 10 SEE countries in the tackled field by harmonising their approach to aggregates management and related policies, and to transferring efficiently the related EU guidelines to the national or regional level. These policies are also contributing to the environmental dimension by promoting the environmentally friendly quarrying, promoting recycling and preventing illegal quarrying. These activities are contributing to the social dialogue with affected stakeholders. Economic activities of private sector operators (large and small ones) are influenced by promoting the positive sides of more socially and environmentally acceptable quarrying activities, leading to positive impacts for the society.

At the EU level SARMa activities coincided with the implementation of the EU new waste management legislation, mine waste management legislation and mineral policy issues. In this way SARMa had a reinforcement effect on the above EU policies by producing practical manuals and recommendations on the best practice measures in the SEE region. Within the networks of

the SARMa partners the recommendations were promoted during the events of the Hungarian and Polish presidency of the EU.

Conclusions

The SARMa project's impact is noticeable at the level of national, regional and local public authorities, where different policies regulating aggregates management and supply from the economic or environmental perspectives are being developed or improved. There are proposals for follow-up projects further increasing capacity of the public authorities and enhancing the involvement of stakeholders in these processes. The project also contributed to the improvement of the EC Raw Materials Initiative, waste management legislation.

Finally, SARMa contributed to the SEE Programme overall objectives by integrating environmental, social and economic aspects of sustainability with respect to aggregates management and supply, capacity building, and fostering transnational territorial cooperation among local, regional, national and transnational authorities.

All SARMa manuals, recommendations and other reports are available at http://www.sarmaproject.eu

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