Joint Pilot Report and Transferability Plan of the *Sava TIES Pilot activities in IAS management*

Interreg
EUROPEAN UNION
Danube Transnational Programme
Sava TIES

Joint Pilot Report and Transferability Plan of the

Sava TIES Pilot activities in IAS management

Interreg
EUROPEAN UNION
Danube Transnational Programme
Sava TIES

Edit: Alen Kiš, Ranko Perić, Klara Sabadoš

Authors:
Ana Tratnik, Gregor Lipovšek (pilot site: Nature Park Ljubljansko Barje);
Haris Hadžihajdarević, Ibrahim Nadarević (pilot site: National Park Una);
Vladimir Stupar, Aleksandra-Anja Dragomirović (pilot site: Protected Habitat Tišina);
Luka Basrek, Ivana Sučić (pilot site: Protected Landscape Turopoljski lug);
Valerija Hima, Renato Bukvić (pilot site: Nature Park Lonjsko Polje);
Mihajlo Stanković, Mirjana Bartula (pilot site: Special Nature Reserve Zasavica);
Ivana Vasić, Ivana Lozjanin (pilot site: Special Nature Reserve Obedska Bara);
Zsolt Molnar, Alen Kiš, Sara Mihajlović, Biljana Panjković, Marko Đapić (the pilot planning and on-site consultancy)

Contents

List of abbreviations

BMP best management practice

IAS invasive alien species

PA protected area

SRB Sava River Basin

Project:	Sava TIES, DTP2-096-2.3
Work package:	WP5: PILOT IMPLEMENTATION
Deliverable:	D.5.2.2 Joint Report on implemented pilot actions and Transferability Plan

Remark:
This document is one of the outputs from the Sava TIES project, developed to jointly serve as the Strategic Framework for effective control of invasive plants in the Sava River Basin.

This project is co-funded by the European Union funds (ERDF, IPA)

Rationale

Invasive alien species (IAS) spreading along the Sava River and its tributaries are occurring incessantly for many reasons, including the lack of experience in IAS management, prevention of their spreading, non-existence of cross-sectoral cooperation and poor or non-existent transnational coordination concerning its control and eradication. Some of the main problems are connected with different and often incompatible national legislation, procedures and restrictions dealing with IAS, especially among the EU and non-EU countries.

In order to increase joint capacities of the SavaParks network to plan and successfully implement eradication activities, seven protected area managers in four Sava Basin countries have implemented pilot actions in invasive species management.

The target IAS species, sites and treatments of the pilot eradication actions in the Sava TIES project have been selected to tackle some of the worst invasive plants widely distributed on typical and threatened habitats in the Sava River Basin. Implementation was at the same time testing both how and where applied methods were effective and the adequacy of certain nature conservation policies. Sometime nature protection goals in protected areas can be contrasted with other site-specific goals within the same habitat (e.g. restoration of native vegetation vs. conserving bird habitats).

The results are presented in the *Joint Pilot Report* (**section "A"** of this document), while the key conclusions and suggestions from the Sava TIES partners after implementing the pilot actions, to other Protected area (PA) managers in the Sava Basin and broader region, are given in the *Transferability plan* (**section "B" of this report**). These findings together with the Cross-sectoral guidelines can be useful for improvements in practice and on the policy level of the PA management.

A) JOINT PILOT REPORT [1]

1. Introduction to the pilot actions:

Considering the fact that invasive alien species are among the two biggest global threats to biodiversity, posing huge ecological, economical and health issues, a special attention within DTP Sava TIES project is being paid to the practical side of IAS management in Sava River basin.

Project partners have selected 7 pilot areas in 4 countries to be test-plots for the IAS eradication, on the PA they are managing. The sample plots are located in areas of high conservation interest: Nature Park Ljubljansko Barje (Slovenia), Protected Landscape Turopoljski lug (site Odransko polje, Croatia), Nature Park Lonjsko Polje (Croatia), National Park Una (Bosnia and

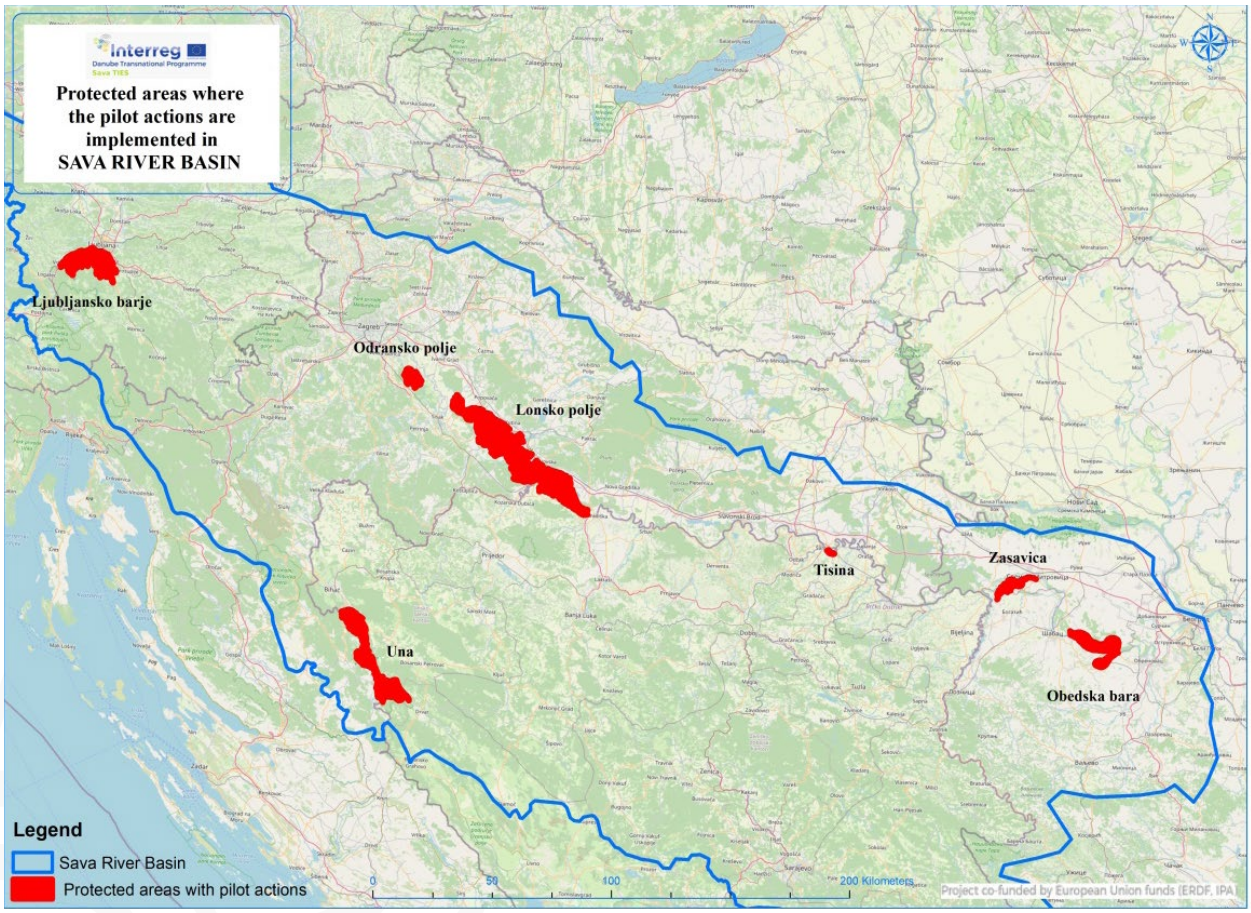

Figure 1: PAs in which the pilot actions in IAS management are implemented

1 The complete reports from the 7 pilot actions are attached as annexes to this document. In this overview are given key remarks from their planning and implementing.

Herzegovina), Protected Habitat Tišina (Bosnia and Herzegovina), Special Nature Reserve Zasavica (Serbia) and Special Nature Reserve Obedska Bara (Serbia). Ultimate goal was to obtain and later share local experience and lessons learned.

The pilot actions have been planned in autumn 2018 and implemented in next two subsequent vegetation seasons. The target IAS species were selected by PA managers as the most challenging for biodiversity in their PA and on Sava basin floodplains. Both effectiveness and costs of different methods in IAS eradication were tested on the invasive plant species.

During the winter 2019/2020 and the beginning of the vegetation season 2020, partners had to adapt the original plans or timelines of their implementation, due to natural events (floods), policy issues (approvals) or for contracted party cancelling external services in IAS eradication.

Each of the implementing seasons began and ended in monitoring of vegetation cover under the specific treatment and species selected as indicators of efficiency. The implementation was followed by midterm reports and final report.

The pilot planning, IAS eradication, the necessary modifications, monitoring of efficiency and making the overall conclusions about the applied method applicability in different natural and legislative framework in the Sava Basin countries, have been implemented in close cooperation between the project consortium.

2. Objectives

Project partners have tested different methods to eradicate or control the most common invasive plants (altogether nine species were targeted) threatening the natural habitats of Sava basin. Plants with fast regeneration possibilities were selected, mostly being dominant at the pilot sites. Most of the selected habitats are dependent on human management (pastures and hay meadows), while the others are endangered by the altered hydrological regimes (wetland habitats) or sensitive to invasions from other reasons (vegetation along the watercourses).

Realization of planned activities also offered some insights into national and local policies considering invasive species. Sometime the same eradication method on the same habitat type in the same category of protected area must be differently implemented, when it faces different national policies and regulations along the Sava corridor, emphasizing the importance of national policy framework.

The cost-efficiency of tested methods have been assessed by comparing the costs and the necessary engagements.

The ecological efficiency of the applied treatments was monitored at all sites by vegetation survey within quadrats of different sizes, from 1×1m to 10×10 m, in accordance with the habitat type. All partners have collected data on the target species, as plant number or/and cover in %, plant height, in some cases stem diameter. In most cases the monitoring has included the other plants growing at the surveyed plot, while some partners have taken a complete phytocoenological survey. Animals depending on the infested habitats were monitored at Odransko polje (corncrake and butterflies) and Lonjsko polje (corncrake, white and black storks).

3. Planning Pilots

In the pilot preparation phase the PA managers listed the most problematic IAS. A comprehensive literature review on the best practices in IAS control was developed (The review of the best BMP). Following a template adapted to the plan development, each of the project partners considered necessary resources, tools and approvals, selected physical and economic indicators of efficiency.

Having essential local knowledge of species which are posing the most ecological and economic threats, the PA managers have proposed at least two sample plots infested by invasive plants to be mapped and cleared of invasive species.

In period of 14-18 September 2018 the 7 sites were jointly visited by external consultant/expert who developed The Mapping and Monitoring Protocol (prof. Zsolt Molnar) and representatives of the Institute for nature Conservation of Vojvodina Province (Serbia) together with the PA managers.

A template for Pilot implementation planning was developed for getting comparative reports of the pilot costs and effectiveness (Annex 1). The methodology for monitoring was drawn in consultancy with the external expert. Both biophysical and economical parameters were defined for monitoring and later evaluation of the pilot measures effectiveness. Following the given scheme, tools, equipment, staff, labour and efficiency indicators and implementation work plan were defined. Technical details of the 7 pilot activities can be seen at pilot overview in Annex 2.

The pilot actions have been implemented by the listed organisations:

Full name of Project partners (PP):

1. Public Institution Ljubljansko barje Nature park (NPLJB);
2. Zeleni prsten Public Institution of Zagreb County (ZP);
3. Lonjsko Polje Nature Park Public Institution (LPNPPI);
4. Public Company Una National Park Ltd. Bihać (NPU);
5. Center for Environment (CZZS);
6. Nature Conservation Movement of Sremska Mitrovica (NCSM);
7. Public Company "Vojvodinašume" (VS).

(The above titles and acronyms are listed as written in the project documentation)

Target invasive alien species - IAS (Scientific, English and local name):

1. *Impatiens glandulifera* Royle/ Himalayan balsam (NPLJB);
2. *Ailanthus altissima* (Mill.) Swingle/ tree of heaven (NPLJB);
3. *Solidago gigantea* Aiton/ giant goldenrod (NPLJB, ZP);
4. *Solidago canadensis* L./ Canadian goldenrod (NPLJB);
5. *Amorpha fruticosa* L./ false indigo (LPNPPI, ZP, VS, CZZS);
6. *Acer negundo* L./ box elder (CZZS);
7. *Echinocystis lobata* (Michx.) Torr. & A. Gray/ wild cucumber (ZP, CZZS);
8. *Reynoutria × bohemica* Chrtek & Chrtková/ Bohemian knotweed (NPU);
9. *Asclepias syriaca* L./ common milkweed (ZP, NCSM).

Recorded other IAS:

1. *Xanthium strumarium* aggr./ common cocklebur (LPNPPI);
2. *Symphyotrichum lanceolatum* (Willd.) G. L. Nesom/ lance-leaf aster, white-panicle aste / panickled aster (ZP Odransko polje, CZZS);
3. *Ambrosia artemisiifolia* L./ common ragweed (LPNPPI Osekovo);
4. *Erigeron annuus* (L.) Desf./ annual fleabane (ZP Odransko polje);
5. *Bidens frondosus* L./ devil's beggarticks (ZP Odransko polje);
6. *Conyza canadensis* (L.) Cronquist/ horseweed (ZP Odransko polje).

4. The field activities and the achieved results

Public Institution Ljubljansko barje Nature park (NPLJB).

(Ljubljansko barje Nature park)

SITE: Large wetland area developed on alluvial plain with exceptionally biodiversity of wetlands valuables as breeding and feeding place for rich birdlifeis threatened by invasive plant species. The most significant natural values are various types of humid and wet meadows and marsh communities which are important for preservation of wetland flora, many Odonata species, amphibians and endangered butterfly fauna.

PLANNED/COSTS: Planned activities included testing eradication and control methods for 4 invasive species at 3 pilot sites:

a. Ribniki v dolini Drage pri Igu Nature Reserve: eradication of Himalayan balsam (*Impatiens glandulifera*) from an area of about 1 ha by mowing/mulching (two times per year for two consecutive years) and pulling out individual plants where mowing/mulching is not possible. Expected total cost was 1500 €.

b. Rakova Jelša: elimination of the tree of heaven (*Ailanthus altissima*) on site by two different method (girdling and herbicide injection). Expected total cost was 1150 €.

c. Škofljica: eradication of giant goldenrod (*Solidago gigantea*) and Canadian goldenrod (*S. canadensis*) on site by four different methods: mowing, mulching, milling by rotary hoe and herbicide application by weed wiper. Expected total cost was 3900 €.

REALIZED/SPENT:

a. Ribniki v dolini Drage pri Igu Nature Reserve: Mulching Himalayan balsam has proven to be effective eradication method although it has to be implemented longer than one year as seeds retain their viability for 18 months and partly mulched plants tend to regrow again so area must be monitored and those remaining plants hand-pulled. After mulching moat of the native vegetation recovered in a few weeks. Hand-pulling was not so effective due to inaccessibility of some habitats to volunteers and to many residual plant parts remaining hidden to volunteers in high vegetation. In both cases numbers and cover of Himalayan balsam plants dropped significantly but, in neither case, completely. Consequently, in cases of using those two methods, eradication need to take place at least two years in a row. Spent: 1043,51 €.

b. Rakova jelša: 10 young Tree of heaven were pulled by extractigator. Two months after eradication developed small shoots growning from the roots that remained in ground. After eradicating of those, no new shoots were observed. Pulling out trees was effective, but work only with young trees. Spent: 427 €.

c. Škofljica: From four applied methods, mowing, mulching, using rotary hoe for milling and application of herbicide with weed wiper the most effective was using rotary hoe for milling but it appear harmful also to native plants. We were not yet able to evaluate method of application of herbicide with weed wiper, because it was done in second year and results are not visible yet. In the quadrants were applied mowing and mulching, the number of goldenrod plants and their cover was lower than in control quadrant, but still high. In case of dense and homogenous *Solidago* stands without native plants recommended eradication methods are

milling by rotary hoe and herbicide application. At places with more native plant species and less *Solidago* individuals less effective but also less harmfull method were mulching andmowing. Spent: 219 €.

Storyteller: The key challenges

As our national FLC requires that all actions implemented under budget line Infrastructure and work need to be done on the land owned, managed or leashed by project partner implementing the work, we had to gain an official agreement from Farmland and Forest Fund of the Republic of Slovenia and Slovenian state forests, d.o.o. who were managers of the area with our Pilot plot 1 in order to be able to claim costs for pilot actions on this pilot plot.

In second year, we were also not able to organise action of hand pulling of Himalayan balsam by volunteers from Biotechnical Educational Centre Ljubljana due to COVID-19 pandemic. Instead, our employees implemented the work.

It was also not possible to test the method of eradication of Tree of heaven with herbicide injection because external service for injecting herbicide in the trees could not be found.

Zeleni prsten Public Institution of Zagreb County (ZP);

(Protected Landscape Turopoljski lug, site Odransko polje)

SITE: Former wetland area with alluvial floodplain complex of grasslands and lowland oak forests embedded within agricultural landscape. The most important natural values are lowland grassland and oak forest communities with accompanying wetland vegetation (especially orchid and amphibious species), rich fauna of fishes, amphibians, reptiles and birds with some rare species (corncrake and Montagu's harrier).

PLANNED/COSTS: Planned activities included testing eradication and control methods for 6 invasive and one native problematic species at 1 pilot site with lowland meadows:

a. Odransko polje: eradication of false indigo (*Amorpha fruticosa*), common milkweed (*Asclepias syriaca*), knotweeds (*Reynoutria* spp., mostly *Reynoutria* × *bohemica*), wild cucumber (*Echinocystis lobata*), common ragweed (*Ambrosia artemisiifolia*), Himalayan balsam (*Impatiens glandulifera*) and wood small-reed (*Calamagrostis epigejos*) from an area of about 4 ha by mowing/mulching (two or, if necessary, three times per year for two consecutive years). After that, the hay, from local meadow with native vegetation, was planned to be spread around to enhance reseeding and revitalization of plant cover. Also, use of supervised fires were planned in October to check their impact on IAS eradication and improvement of biodiversity. However, in later stages of planning this pilot area was divided in two sub-areas of approximately 2 hectares each. On the southern sub-area hay spreading and burning were planned, and the northern area was supposed to be only mulch-mowed and mowed. Expected total cost was 25800 €.

REALIZED/SPENT: Eradication methods had been applied predominantly on 2 planned target and one additional target invasive species (*Amorpha fruticosa*, *Asclepias syriaca* and *Solidago gigantea*) on two pilot sub-areas. All bush and tree vegetation on these areas was removed by mulch-mower. After mulch-mowing, the hay from the local hay meadows was spread in part of the area. Due to administrative obstacles, mulching-mowing was carried out only partly in September 2019 and finalized in December 2019. Therefore, the hay was also spread on the part of the southern area. Due to the very wet autumn, the planned burning wasn't possible, but eventually this has proven to be justified because according

Figure 2: Himalayan balsam growing at tall-herb forest edge along the stream Draščica.

to advice received from managers of protected area in Hungary (during the study visit), burning could initiate spreading of *Asclepias syriaca*. After mulching/mowing, false indigo started to regrow across open habitats from plant parts that remained under the ground and also from the seed bank, almost doubling its number over 2 years. Also other invasive species like *Erigeron annuus* and *Asclepias syriaca* flourished. Nevertheless, this is considered as a success, because it created a dense low shrub which could be controlled with much lighter machinery at five times lower costs. Also, it appeared highly effective against *Solidago gigantea* greatly reducing its number. Spent: 19.126,99€, 5.041,53 €/ha.

Storyteller: The key challenges

IAS control by mulch-mowing had to be postponed for emerged bureaucratic conflict in the conservation targets. For the corncrake nesting the eradication activities were postponed by rulings from higher governance to period after 15th August, when false indigo already formed offshoots higher than 1 m. If we were able to remove invasive alien plants before May, we would be more effective and, could slow down the regeneration of invasive alien plants even more. The pilot action revealed a policy gap: although the meadow was completely overgrown in false indigo bush, and can be considered only as potential breeding site for the target bird species that need revitalization. The legal ban refers to the habitat type recorded on habitat map of the protected area and Natura2000 site. The issue is significantly reducing effectiveness of the IAS control, because the late mowing cannot exhaust the root system of the IAS species and it can continue in establishing new shoots.

Based on the experience with our pilot actions, we would recommend continuing the collaboration with the Ministry of Agriculture and Ministry of Economy and Sustainable Development. They especially need to be supported in changing current rules for Agro-Environmental Scheme and

related nature conservation measures and restrictions based on the experience with implementation.

The experience with spreading hay from local meadows resulted in a slowdown in sprouting of all plants, not just invasive ones. One of the possible reasons is the too large quantity of the spread hay forming thick layer on the ground. We have also noticed that the hay didn't contain much seed. When we brought it to our pilot area, it was already dry, and it was already transferred to several different locations. The seeds were probably partially lost in that process. For that reason, if we would get the chance to test this method again, we would bring the freshly cut grass from the local meadows, we would let it dry on the pilot area. In that process, it would drop seeds directly in the pilot area, and then we would remove it.

Lonjsko Polje Nature Park Public Institution (LPNPPI)

(Lonjsko Polje Nature Park)

SITE: Typical wetland landscape with lowland floodplain forests, humid grasslands, semi-aquatic and aquatic habitats developed along the river Sava. Seasonal flooding feeds the wetland landscape and support rich flora and fauna, especially endangered aquatic and amphibious flora, fishes (spawning place), amphibians and various birds (feeding and nesting place). The wetland habitats are managed by traditional grazing.

PLANNED/COSTS: Planned activities included testing eradication and control methods for 1 main invasive and other present invasive species at 1 pilot site with dense Amorpha fruticosa stands:

a. Osekovo west: eradication of false indigo (*Amorpha fruticosa*), from an area of about 8 ha by BioBaler and its use as firewood/heating in a cement production factory or for firewood pellets manufacture. The opportunity in combining the IAS removal (false indigo) with energy production sounded like a win-win situation, which should be supported by the business initiative (bio-balling the false indigo). The meadow would not be covered by wooden mulch hindering

Figure 3: The pilot area during the 2nd year of eradication.

the native species propagation. Since no such service could be found in Croatia, the bioballer was promisingly found in Hungary In order to avoid conflict with forestry only non-forested habitats were considered as feasible for realization of this idea. In later stages the plans were changed: an area of about 10 ha was planned for eradication by mowing/mulching, but leaving all biomass on the ground. One part of this area was scheduled to be grazed by cattle (0.5-1 cows/horses per ha until 15th May and again after the 15th August, in the meantime it was planned to be maintaned as nesting and feeding place for endangered birds) while the second part of area is planned to be fenced and mulched again (with one "control" hectare left fenced as reference site for monitoring spontaneous progress of vegetation). Expected total cost was 37.115,00 €.

REALIZED/SPENT: Due to unexpectedly complicated documentation and high cost of transporting bioballer from one to the other country, the contracted party suddenly cancelled the service and eradication method had to be changed. Tthe originally planned method was changed to mulching-mowing. After initial monitoring of vegetation, 10 ha of grassland infested by Amorpha was machine-mulched (external service) with biomass leaved on the ground. After that, one part (6 hectares) of the pilot site was subjected to grazing, the second part (3 hectares) was fenced and mowed/mulched and the third, smaller part (1 hectare) was fenced and the spontaneous progress of Amorpha fruticosa was monitored. The target subareas were then subjected to mowing (at least once a year) and grazing. In smallest part only five months after eradication, growing from roots, seeds or from young plants which survived, Amorpha fruticosa reached a height of 2,5 m and completely covered the area. Similarly on mulched/mown area Amorpha quickly resprouted and by 15th of August 2020 reached a height of 2 m and completely covering the area. Another mulching was the only option. Third, pastured area has shown the best results in terms of height of amorpha, number of stems, degradation of habitat and distribution of IAS. Spent: 1.550,00 € + VAT per hectar.

Storyteller: The key challenges

Lonjsko Polje Nature Park Public Institution made market research before public procurement and we had some inputs that the biobaler is available.

After public procurement was carried out, LPNPPI got the candidate, which claimed with written statement that he can do the job with biobaler. But, after signing of the contract, when implementation of pilot activities should start, LPNPPI found out that this company couldn't offer the service of biobaler (there was no biobaler in Croatia). Also, the option was biobaler from Hungary but the cost of transporting biobaler was too high. As a result, LPNPPI had to terminate the contract with that company. Because of situation development, the original AF pilot site method was changed to mulching/mowing with grazing (partly).

Nobody was truly interested into bales of biomass of *Amorpha fruticosa*. The cost of transport to the cement plant in Osijek was too high. This species requires special technology in the production of pellets we could not obtain.

Similar to the upstream located Odransko polje, the PA manager faced the conflicting conservation targets: one of two potential pilot sites, planned for mulching the false indigo was registered as the corncrake nesting site.

In November 2019 the flood occurred so because of hydrological conditions the mulching activity have been postponed till April 2020, when *Amorpha fruticosa* was finally and successfully mulched.

Figure 4: Grazing false indigo (*Amorpha fruticosa*) stands after mulching;

Figure 5: Claas Celtis 90KS, mulcher: Berti TSB 230.

Public Company Una National Park Ltd. Bihać (NPU)

SITE: Mountain landscape in the upper part of the river Una valley with waterfalls and various riparian and chasmophytic habitats along the river Una and its tributaries. Key natural values include exceptionally diverse vascular flora with many Dinaric endemic forms, rich butterfly and mammalian fauna.

PLANNED/COSTS: Planned activities included testing eradication and control methods for 1 invasive species at 2 pilot site:

a. Račić: eradication of Bohemian knotweed (*Reynoutria* × *bohemica*), from area of unspecified size by combination of the following methods: 1) pulling out with the help of hand tools (Pulaski axes, shovels, motor trimer) and plastic bags); 2) grazing by goats (at asparagus phase of shoots); 3) cutting and injection, followed by chemical application of glyphosate. Expected total cost: not-specified.

b. Kulen Vakuf: eradication of Bohemian knotweed (*Reynoutria* × *bohemica*), from area of about 200 m2 along the river Ostrovica by the same methods as above with the exception of chemical treatment due to the proximity of waterway. Expected total cost: not-specified.

REALIZED/SPENT:

a. Račić: invasive species were pulled out and after that the site was regularly grazed. The effects of grazing and mechanical removal were checked on two subareas: 1) after pulling-out all individals the subarea was grazed by goats but this method was unsuccessful; 2) the plants were only pulled out.

b. Kulen Vakuf: after hand-pulling plant remains were treated with glyphosate (by applying it to stems in the initial growth stadium in spring 2019 and after that to the cut stems in November 2019). The efficiency of 4 different combinations of cutting/herbicide treatment was monitored on 4 experimental plots: 1) plants were cut off and after that its roots were hand-pulled out; 2) plants were only cut; 3) herbicide (Glyfosat) was applied on leaves only; 4) plants were cut and Glyfosat applied to their stems remains.

After the failure with the browsing by goats, the alternative method was implemented: smothering the infested area with heavy-duty black plastic sheeting and weighted down by earth (Figure 6). In doing so, ground underneath will be deprived of sunlight and water.

Knotweed steams were cut by motor trimmers and hand tools at ground level. As Japanese

knotweed stalks are woody and could damage the plastic sheet, heavy hammer and pulaskis were used to remove or crush sharp objects (including the sharp cut stumps) from the area as possible,. After the the sheets were layed down, there were covered by mulch and removed stems of the Japanese Knotweed steams to keep yard aesthetically pleasing.

The method is based on exhausting the knotweed, which is known to keep nutrient reserves in the underground parts. Experiences in other countries have shown that the effects of the method can be **expected in several years.** Considering the site is a one of the tourist hot-spot in this regions and the Una River is a true pearl in the Sava Basin, it is very important that the method received positive reactions from public, compared to the one the herbicide usage.

The results of this method cannot be expected by the end of the project, it takes few years to achieve its full effect. Spent: 1635 € (cost of the equipment is not included).

Storyteller: The key challenges

Initial plan was to implement all testing methods on territory of the National park which however could not be implemented. Usage of herbicides as management practice is uncommon in protected areas of Bosnia and Herzegovina due to high level of well-preserved habitats in this country. Consultations and hesitation in herbicide approval, although in controlled and selective manner (injecting into knotweed stems), resulted in re-allocation of the sample plot out from the National Park.

The another quite unexpected obstacle was that the goat browsing, as the biological method in removal of knotweeds could not be implemented since the goats, in contrary to transnational experience, did not want to eat the young plant shoots of knotweeds, emerging from roots after mechanical/ hand removal. The PA manager explained that the goats and cattle in the region are used to graze on high quality pastures which are plentifull in this biodiversity-rich countryside. The issue resulted in method change: smothering the infested test-plot by thickblack plastic sheet, after the knotweed shoots were cut down.

Figure 6: Left: Goats on the first pilot site (Račić), in contrary to foreign experience, didnt browse at all any young Bohemian knotweed stems. Right: covering the infested plot by black plastic sheet.

Center for Environment (CZZS)

(Pilot site on the teritory of Protected Habitat Tišina)

SITE: Lowland pond as a remain of the former Sava river oxbow with characteristic wetland flora (especially aquatic species) and diverse and rich fauna of fishes and birds (important nesting and breeding place).

PLANNED/COSTS: Planned activities included testing eradication and control methods for 3 invasive species at 1 pilot site:

a) Bara Tišina pond shoreline: eradication of false indigo (*Amorpha fruticosa*), box elder (*Acer negundo*) and wild cucumber (*Echinocystis lobata*) from an area of about 2.4 ha by mulching/mowing, cutting, mechanical pulling out (and also girdling in case of *Acer negundo*) and biomass removal after which was planned planting few thousand individuals of native fast-growing tree species (*Populus alba*, *P. nigra*, *Salix alba*) and, if possible, regular grazing. Part of field activities on eradication was initially planned to be carried out by volunteers in frame of three working/educational camps planned to be organized on the pilot site. Expected total cost: 29810 €.

REALIZED/SPENT: During first months of 2020 False indigo (*Amorpha fruticosa*) stands were manually trimmed and cut and after that again cut down to the ground. This sparked aggressive response and population quickly revitalized sending numerous ofshoots and forming even denser (up to 75%) shrub cover than before. Some other, otherwise less significant invasive species also responded with vigorous regrowth (*Bidens frondosus*, *Solidago gigantea*). However, new formed shrub layer is consisting only of low bushes up to 1,5 m high, compared to previous large bush formations up to 5 m high. Individual trees of the box elder (*Acer negundo*), present with low numbers were only girdled. The presence of wild cucumber (*Echinocystis lobata*) didn't change in a distinct manner. After eradication biomass was collected and transported out of protected area. Cutting down remnant box elder trees and planting area with up to 3500 native trees was scheduled for later. In the implementation phase was found that plant nurseries in Bosnia and Herzegovina did not produce plants of native poplars, so the planting for the habitat restoration was done using other species autochthonous to the site (*Quercus robur* and *Fraxinus angustifolia*). The activity on was implemented by an external service, including the afforestation. Besides, organizing the volunteer camp was not considered as eligible cost, so the external service had to be contracted to implement the entire pilot activity. Center for Environment with in this project supported development of first management plan for "Tišina" protected area (officially proclaimed in late 2019). Very important aspect of this management plan is that it includes recommendations for management of IAS-based on experience from SavaTIES project. Drafting this document was supported through this project, budget: 10000 euro.

Considering the protected area was designated just recently, in support of the IAS management also the first management plans for Protected Habitat Tišina was developed. Spent: 29.810 €.

Storyteller: The key challanges

The old oxbow Tišina is territorially shared between two constituting units of Bosnia and Herzegovina (Federation of Bosnia and Herzegovina and Republic of Srpska), where only the (larger) part within entity of Republic of Srpska is a protected area. Different legal status and lack of developed cooperation between the site managers was an issue that made simultaneous eradication on the both administrative parts of the Tisina site unfeasible during the pilot implementation. Legal approval for the fieldworks on the protected area was issued from Institute for the Protection of Cultural, Historical and Natural Heritage, in charge for the territory of Republic of Srpska. The works had to be implemented on the public land, as the private land consists of lots of parcels

shared among numerous land owners, similarly to the other Sava River Basin countries.

Luckily the option of managing invasive species without herbicide application was administratively "treated" as a regular maintenance of green areas and therefore accomplished without complications.

Also, planned volunteers participation in work on IAS removal couldn't be implemented as the consultancy from the First Level Control in 2019 showed that organisational cost (sandwiches, refreshments and transportation), not being planned as within an external service, cannot be considered as eligible. So the project partner had to implement the eradication works by going through budget change approval from the Joint Secretariat followed by contracting external service company („Slobodna zona" Šamac). The budget reserved for the eradication activity should consider „catering cost" for events where sandwiches and refreshments are needed, such as involving volunteers. Also the travel cost must be planned if the site is distant from the coordinating office, like in this case.

Although combination of mechanical control was planned to be followed by cattle grazing, in villages around the site was not a cattle breeder interested to put the herd on the restored habitats. It is partly consequence of general trend in farming reduction, and partly to the fact that arable plots are close to the site and cattle owner should either invest in fencing the herd or should spend all day in watching cattle instead of working on other tasks as used to do. The cost of fencing should be planned within the IAS management budget, as the small cattle breeders are not able or willing for such investment. Daily engagement in setting and removing the fence should also be considered as the fence can be taken away or wild boars could damage it overnight.

Nature Conservation Movement of Sremska Mitrovica (NCSM)

SITE: Small river developed in oxbow of the river Sava with various wetland, forest and pasture habitats embedded in agricultural landscape. It is characterized with rich vascular flora (especially aquatic and semi-aquatic species) and significant

Low false indigo (*Amorpha fruticosa*) shrub layer formed after cutting and trimming at pilot site near Tišina bara.

Afforestation action, March 2021, PA "Tišina"

number of amphibian and bird species (important as feeding and nesting place). Pasture habitats are managed by rare domestic livestock breeds.

PLANNED/COSTS: Planned activities included testing eradication and control methods for 1 invasive species at 1 pilot site:

a. Valjevac: eradication of common milkweed (*Asclepias syriaca*), from an area of 52 ha by 3 methods: 1) on area of 1 ha is planned hand-pulling; 2) on area of 1 ha is planned herbicide application (manual painting of the cut stems with 2,4-D and Glyphosate); 3) removal by rotary cutter on area of 50 ha. In the second year certain parts of this subareas will be treated again: herbicide application on 0,5 ha, hand pulling on 0,5 ha and rotary cutting on 1 ha. Expected total cost: not specified.

REALIZED/SPENT:

Works on eradication of common milkweed started in September 2019 (not in spring as it was planned) which negatively affected outcome. Common milkweed was eradicated by hand-pulling (on 1 ha), by herbicide application (on 1 ha) and by tractor-mulcher (on 50 ha). In the second year (2020) the same methods were repeated on the same plots but on smaller area: hand-pulling on 0.5 ha, herbicide treatment on 0.5 ha and mulching on 1 ha. Short time after hand-pulling and mulching new plants emerged (although on smaller scale) which should be attributed to powerfully developed underground parts of plant which is hard to extricate completely by both methods in financially and economicaly sustainable way. On the other hand, herbicide application appear to be quite effective method with success rate of 40-60 % and no new plants emerging after treatment but it should be applied with exceptionally care (only manual treatments localised on the IAS specimens) in initial stages of invasion i. e. on habitats with ± developed natural vegetation and on habitats along the water bodies. Spent: 30000,00 €.

Figure 8. Mulching of common milkweed (*Asclepias syriaca*) on Valjevac pasture.

Storyteller: The key challenges

External service in IAS removal is costly and under the INTERREG projects can be contracted only after public procurement in most cases. The so-called PRAG procedures in the procurements are developed for EU-financed projects in non-EU countries. The rules are quite demanding and time consuming, which postponed mechanic IAS removal (common milkweed) from optimum springtime to late summer time.

Additionally, price for mechanical mowing by rotary cutter was high due to uncalculated bush presence on the pilot sites. The price would be less than a quarter of the paid sum, if only herbaceous plants were on the pilot site.

Public Company "Vojvodinašume" (VS)

SITE: Wetland area with remnants of aquatic and semi-aquatic habitats preserved in the Sava river oxbow and surrounded with fragments of lowland riparian forests, humid meadows and agricultural landscape. Most prominent natural values are vascular flora and vegetation characteristic for large lowland wetland ecosystems (including lowland peat habitats), diverse and rich fauna of fishes and birds (very important nesting and feeding place, numerous colonies).

PLANNED/COSTS: Planned activities included testing eradication and control methods for 1 invasive species at 1 pilot site:

a. Krstonošića okno: eradication of false indigo (*Amorpha fruticosa*) and native but unwanted species (*Ceratophyllum demersum*, *Salix* spp.), from an area of 18000 m^2 by: mechanical pulling-out using wire-rope installed on tractor and removal (by backhoe) of upper soil surface containig the false indigo seed bank. The method sets on premise that removing false indigo bushes together with the root system (which very dense and keeps soil on it) lower the altitude to the level of original habitat (to rejuvenate the marsh habitat), that is most of year round slightly under level of ground water. In doing so, the false indigo will not be able to recolonize the area as the key environmental condition is not any more suitable to a wooden vegetation. Maintenance after initial works was planned by mowing/cutting the terrestrial and water vegetation by mechanization (backhoe, hedge trimmer, chainsaw, aquatic weed cutter). Expected total cost: 40.000 €.

REALIZED/SPENT:

Initially planned eradication method by mechanical pulling-out using wire-rope installed on tractor was implemented, but only on test-method level. Still, by accessing the effects, human sources, timeframe and costs needed for this eradication method, further removing was done also mechanically but with different method – total removal by backhoe of the upper soil surface containing the false indigo seed bank with parallel opening of water area.

In the first year (2019) false indigo together with other vegetation was mechanically pulled out opening new habitat of free water surface (1.8 ha) and creating meadow habitat (6 ha). However, the biomass mixed with upper soil layer was not removed immediately but later, demanding additional costs. Shortly after finishing these works some IAS resurfaced on the pilot site, so it is necessary to introduce grazing as sustainable option for IAS management. Maintenance after works was implemented by mowing/cutting the terrestrial and water vegetation by mechanization (hedge trimmer, chainsaw, aquatic weed cutter). Spent: 39.752 €.

Storyteller: The key challenges

Upon field work completion on extracting IAS with roots (dense tickets of false indigo) the contracted service provider did not remove the biomass and sludge from the shore, creating an embankment that would

be suitable for re-inhabiting the invasive species from surrounding area (*Acer negundo*, *Amorpha fruticosa*, *Echinocystis lobata* etc.). Biomass with the soil was removed by the PA manager engagement at additional costs.

When planning the habitat rejuvenation, it is necessary to take into account that the transportation distance of removed biomass with soil on the roots can be fairly long and that can significantly increase the eradication costs.

Figure 9: Pilot site before (left) and after eradication (right).

This project is co-funded by the European Union funds (ERDF, IPA)

5. Informing public and promoting the achievements

Throughout the implementations of planned works in the pilot sites, the partners were informing local stakeholders and public by local and international media by posting photos and reports from the field activities. In addition, websites of the project partners translated and reported the actions from the other pilot sites.

The pilot areas were also filmed for a promotional Sava TIES film, giving the public insight into the implemented activities and achieved results, above others. The film can be watched on the link: **https://www.youtube.com/watch?v=KfW-ICqBf-k**

Sava TIES - Sava river: an important corridor for animals and plants.

Figure 10: Sava TIES promotional film about natural values and the threats

B) **Transferability Plan**

Experiences and practical knowledge about methods for eradication and control of IAS acquired during pilot actions, adapted and improved within the post-implementation conclusions, can be substantial for successful dealing with IAS problems in similar future actions on the regional scale, not only within the Sava river-basin area. These areas have similar landscapes, physiognomy, vegetation cover and they faced almost identical IAS, as well as problems during their eradication and control. They include protected areas and sites which were not encompassed by this project but represent parts of national and the European ecological network NATURA 2000 ("Spačva" in Croatia, "Bosut Forest" in Serbia, "Bardača" in Bosnia and Herzegovina). In addition, resembling wetland habitats and the same invasive species are present along many European rivers acting as ecological corridors.

From the policy perspective, the legislative constraints which the Sava TIES partners had to deal with during the pilot implementations were some sort of practical gap-analyses, useful to the policy development.

If the lessons learned by all partners will be properly and fully acknowledged by the state authorities responsible for forest management, water management, agriculture, nature-based tourism and other similar business and activities depending on the preserved natural ecosystem services, they all could benefit together by the efficient nature protection.

The next chapters briefly describe steps which could help in planning and carrying out activities of IAS control and eradication in the wider region.

1. Planning actions in IAS control

Before entering into process of planning it is necessary to gather information about presence of invasive species, then how IAS are distributed in the area of concern and which habitat types are infested. For planning of this kind several useful outputs from the Sava TIES project can be of particular importance: Pilot Template (Annex 1), the *Review of Best Management Practice in IAS control* and the *Cross-sectoral guidelines for joint management, control and eradication of invasive alien species in the Sava River Basin*.

These handbooks on IAS control can be used as framework in IAS management. A site-specific knowledge is required in consideration of all necessary resources, tools and approvals, selection of efficiency indicators as well as scope of actions adapted to the local circumstances.

1.1. Selecting species and sites for actions

Mapping the invasive species distribution and recognizing pathways of their spreading in a target area is the first prerequisite for successfully controling them. In order to get comparable and uniform results, before mapping any IAS in any area, a detailed map with habitat types in the area (if not all, then habitat types important for nature conservation i.e. habitats listed on EUNIS or the EU Habitat Directive) must be produced. Depending on the mapping scale and the present IAS species,

different mapping methods can be used, explained in the *Mapping and Monitoring Protocol* where „Field manual“ depicts habitat-atributes helpful in making priorities (such as: infested habitat type, infestation phase, presence of IAS pathway).

In a simple way the data can be mapped using the mobile application “IAS in Europe” downloadable from Google play store, which register the IAS findings in the EASIN database (more about in the Cross-sectoral guidelines). In addition to the habitat map, useful information can be found in forest or water management plans issued by state authorities.

Since the available resources for eradication are, almost as a rule, everywhere limited, the eradication should firstly be focused on cases where a new or the most noxious invasive species are threatening the most imperiled priority habitat types and protected species, especially in particular cases where initial infestations linked to the rivers, canals, roads, infrastructural corridors and other IAS pathways occur.

Sometime a functional compromise can be achieved, such as: eradicating the IAS on the key pathways like rivers/canals and containment of IAS like black locust by keeping it away from ecological corridors and isolating with dense strips of natural treees and shrubs.

1.2. Policy check and stakeholder analyses

IAS related dependencies, conflicts and risk management issues

Physical (visual) efficiency in eradication IAS is definitely the prerequisite for evaluating the activity outcomes, but when considering the long-term positive impacts other things also can be important. The IAS control/eradication plans should carefully take into account the interests of stakeholders, because there is usually the common cause or at least some kind of agreement (*raison d’être*) within many local communities that some or all local IAS are noxious and economically and financially demanding. This reflects the need that prior formulating is important to explore possible potentials for intersectoral and other types of cooperation. It further helps to evaluate unexpected/ unutilized possibilities which can be offered by local stakeholders in IAS eradication. Also, unrevealed trade-offs and conflicts between stakeholders and the land management objectives can hinder the eradication achievements.

For example as the experience from pilot site Odransko polje revealed, bureaucratic conflicts between nature protection objectives (bird nesting and IAS eradication) emerged from the environmental policy (due to the lacking of deeper, detailed regulation) and postponed the eradication of IAS (*Amorpha fruticosa, Solidago* spp.) over two months from the optimal spring period, thus decreasing its efficiency.

Also, public opinion and initiatives towards herbicides ban on European level (which came forth in the second year of the pilot implementation), can influence herbicide usage, even in strictly selective and rationalised way (such as injecting a herbicide to an IAS away from water habitats).

During the pilot actions there has been also a disagreement with honey producers (beekeepers) whose income rely on invasive species rich in nectar or pollen (*Amorpha fruticosa, Robinia pseudoacacia, Impatiens* spp., *Solidago* spp., *Reynoutria* spp.). What a PA manager considers as habitat restoration, they might recognize as devastation (bee keeping on black locust or false indigo vs. habitat restoration). The small entrepreneurs are usually from rural households, whose livelihood is anchored in the accustomed land use. They often need support in both knowledge and financial means to adapt their land use practice for the IAS control, either by changing the problematic species with an appropriate non-invasive or by managing the species to prevent its dispersal to sites where it causes problems.

Seasonal floods are often used in wetland habitat maintenance. However, when planning IAS eradication it must be counted as IAS vector. For instance, pilot actions may be affected by the floods and/or backwaters, in presence of floating seeds of false indigo (*Amorpha fruticosa*).

Tab. 1. Dependency matrix: Some examples of linking stakeholders with the IAS impacts.

Stakeholder (e.g.)	Negative effect of the IAS	Positive effect
Small forest owner		Firewood from black locust, low-cost firewood production enhanced by spontaneous regeneration of woodlots made from IAS
Large forest owner	Increased cost of oak regeneration	
Water management company	Higher cost in maintaining waterways and levees overgrown by IAS	
Local government	Increased costs of the maintenance of canals and local roads	
Beekeper		Rich nectar and/or pollen resources, often in the vicinity of the settlements.
Tourism operator	Deteriorated landscape	
Owners of agricultural and forest land	Increased costs of production, additional maintenance of canals/ditches.	

The stakeholder and policy analysis must be perceived as indispensable and essential action before any IAS eradication planning or asking fieldwork approvals for own staff/ subcontracting external service.

1.3. Developing IAS management plan

Which Method to apply?

Depending on the invasive species composition and distribution and the characteristics of the area, the appropriate method of IAS control must be chosen: biological, mechanical or chemical, or a suitable combination. *The Review of Best Management Practices* and the *Cross-sectoral Guidelines* have extracted examples on successfully implemented actions worldwide, but the method implemented on other sites can seldom be just copied without any adaptation.

Methods presented in the pilot reports are based on local experience, however there are still many variables depending on habitat sensitivity, proximity of watercourses and other IAS pathways, different local interests, state and local policies and ownership issues. Those are factors which can affect the implementation and should be carefully considered. Invasive species removal is demanding in resources and labour, so any win-win situation with other stakeholders should be recognized.

If there is any chance to involve local communities and their land use customaries in IAS control, it would be the best cost-effective solution. For instance: rural households are often using thin firewood for heating – they could be involved in voluntary removal of woody invasive species often thriving in forest understories. But caution, the firewood from areas infested with IAS species should not be extracted in periods when these IAS have mature seeds.

If there are cattle/pig breeders and the habitat is suitable for foraging - bringing back the traditional land use practice (forest pasture, transhumance, seasonal pasture) could be a cost-effective way in suppressing some IAS susceptible to grazing and trampling.

The chosen method must be conformed with any national policies related to herbicide application, activities on private and public lands, legislations on nature protection and other natural-resource-management policy (forestry, agriculture, water management, etc.). The analysis of national policies reveals that these legislative background and legal procedures pertaining to IAS management are quite differing across the Sava Basin countries (depending on management method, habitat priority, sensitivity, etc., more information can be found in the Joint policy review among the Sava TIES deliverables).

In the planning phase, it would be advisable to contact the above listed pilot implementing organisations for more information about the results and challenges during the pilot implementation. Also, very instructive for planning own IAS control and eradication methods, it would be recommendable to visit other sites (if possible) where prospective methods have already been implemented. During the project, the Sava TIES consortium jointly visited national parks in Hungary, where different methods of IAS control (biological, mechanical and chemical) were successfully implemented.

Selecting indicators of efficiency of IAS control

When analysing efficiency of some IAS control method, many factors should be taken into account *e.g.* biodiversity concerns, cost-efficiency, impacts on human health and other, depending on local circumstances.

These indicators can reflect the efficiency of particular activities concerning their **output, outcome and impact**. Those three categories are quite easy to understand by examples. For instance, the **output** of the Sava TIES project is the mobile application for mapping IAS in Sava River Basin and the mapping protocol. The **Outcome** from using those two is an informative database showing the distribution of IAS along the international river corridors. The **Impact** would be that the SavaParks Network have built operative tools/infrastructures for the early warning system and rapid response in transnational IAS control. Additional indicators for those three categories, respectively, can be:

- A developed application and protocol for IAS mapping & monitoring
- The number of the mobile app users
- The number of IAS records in the database and management plans developed after the IAS distribution analyses.

Also, for effective monitoring during on-field eradication indicators must have reference points (e.g. number of IAS plants, their cover in %, height in units, financial cost per unit area) and defined frequency of monitoring.

A general rule for defining indicators is well-known **SMART** approach.

The acronym stands for:

- **Specific** (avoid using bias and unclear indicator such as “improved”);
- **Measurable** (e.g. the percentage of IAS and native species cover/height/density before and after the activity);
- **Achievable** (e. g. one time mowing annually without follow up grazing resulting in later IAS resprouting is not an effective way of eradication/control);
- **Relevant** (are the priority habitats and key species sensitive to the IAS? Does the IAS control meet land management goals?);
- **Time-bound** (e.g. the knotweeds are hardly expected to be eradicated in less than several seasons, but setting the targeted effect to over ten years would dilute the efficiency and increase risk of IAS dispersal).

IAS affect both market and non-market values (timber, crop, soil, but also landscape features, protected native species). Thjerefore qualitative

and quantitative indicators can be used in both cases (e.g. cost of silviculture and percentage of a meadow area cleaned from IAS).

Defining indicators:

In order to initiate policy and decision makers to offer support for IAS control, it is not only important that the physical effect is assessed but also the economic background of the implemented actions. So, in addressing the efficiency and the later impacts of particular actions on IAS eradication and control, physical and economic indicators are important.

For the cost-benefit analyses of planned actions, engaged resources and benefits from each action must be calculated. Economic parameters include costs for staff in planning and monitoring, eradication and equipment costs, travel costs, overheads and costs for externals services if necessary. The costs must be displayed per unit area for later cost-efficiency analyses and dissemination among other PA managers (€/ha for revitalized area).

Economic support from the sector policies

The funding for IAS control actions can be drawn from a budget allocated to PA management, compensation measures and agri-environmental subsidies for the habitat maintenance. Co-financing from different sources is the best way to improve the necessary cross-sectoral cooperation, which is essential for the control of IAS. There are numerous currently unexploited sources, mentioned in the Cross-sectoral Guidelines.

Workplan and timeframe of activities

The work plan should be adapted to the site specificities in environmental, social and economic backgrounds. The natural assets such as protected areas involve diverse stakeholders from both private and public, business and non-profit sectors, which all have some needs and aims to exploit, , or to manage or just to enjoy nature. The timeframe of the actions should tend to harmonize the above mentioned factors for successful implementation of a work plan.

There are some particular periods for actions which should never be missed out, such as mowing herbaceous IAS before fruiting (best time is just before blooming), the extraction of wooden IAS in periods before their seeds/fruits are ripend, applying herbicides in periods when the plants start to transport the nutrients to their roots etc.

1.4. Issuing approvals

The implementation of IAS eradication activities face a number of legal preconditions, which must be listed and issued during the planning process. Approvals, conditions and fees, apart from those from nature protection may come from other sectors (forestry, energy, agriculture). Systematically planned activities in IAS control at global level are of recent date, from the end of the XX century and there is a lack of detailed regulations dealing with this issue , even the harmonisation with other regulations is far from being completed. In addition to the relatively small number of implemented actions, the Sava River Basin is also characterized by different legal systems, which regulate same issues and situations differently.

Approvals necessary for IAS control depend on the targeted land category, the ownership status, verified management plans and other site specifics. Useful information about the issues are given in the Cross-Sectoral Guidelines.

For each of the methods in IAS controlling (mechanical, biological, biological-mechanical, bio-chemical and chemical) in protected areas, there are certain conditions that contractors must adhere to. The legislation in the countries of the Sava River Basin and rulings of particular organizations/agencies in charge of nature protection of specific protected areas regulate the conditions under which the works in IAS control can

be conducted (these conditions are not always favourable, for example time limitations of work based on the nesting period of protected species are sometimes applied to whole protected area instead of site specific plots i. e. relating to sites where these protected species actually live).

Approvals:

To obtain necessary consents, one must know the type of land ownership (who is the land user), cadastral culture (forest, meadow, pond, etc.), vegetation layer etc. in which the invasive species is present. Sometime the biomass of the invasive species is a valuable resource (wood, fibre, hay, fruit) registered in a management plan (e.g. forest management plan). The IAS removal in such cases requires additional consent from the resource manager and their supervision at a state level.

Insufficient experience in IAS eradication may result in non-recognizing legal obligations to obtain the necessary consents and conditions for works. For example, although a meadow is completely overgrown with invasive species, if it was officially registered as habitat of a protected bird nesting site species (e.g. corncrake), the activity must be temporally and spatially harmonized with current regulations, making it impossible to successful revitalize the degraded habitat. Necessary approvals might stay forgotten until a legal issue at once holds the eradication (e.g. rulings from other sectors approval for herbicide use in PA, eligibility of actions on private lands in the PA, conflicts between conservation targets).

In protected areas, the conservation objectives and rulings of nature protection could also determine how the obtained biomass is treated, i.e. how it is further used (burned, transported to a local landfill or to other dedicated place).

2. Field activities

After careful planning and developing a working plan with determined activities, milestones, indicators, resources and approvals (check the Template in Pilot Planning - Annex 2), the implementation can start to take place.

The mechanisation and other tools used in IAS removal should always be checked and cleaned from IAS propagules both before and after any activity, to avoid IAS spread from the site to another.

In addition to carefully depositing them on a controlled place (away from vectors and pathways), biomass infested by IAS seeds and other propagules (roots, viable stems) should be transported in closed containers and covered, to prevent accidental seed dispersal.

Land owners/managers should be timely informed in matters of their concern (entrance to private land, removal of biomass, planting/seedingof autochthonous species).

External service staff should be reserved early for monitoring at the planned time (before eradication, meanwhile and after the seasons of the implementation), for getting the right conclusions about the eradication efficiency.

Implementing work plan:

Follow your plan and adhere the activities in eradication and monitoring to the timeline

Media coverage of the activities is of great importance, to get support and to avoid misinterpretation of the overall efforts. The reporting should follow the activity implementation which usually extends to several seasons, bringing the focus to values emerging from the IAS removal (e.g.: reduced risk of waterlogging and creating congestions in canals and rivulets, higher quality of

grasslands or more diversified honey pasture as a restoring result, cheaper maintenance of green areas such as parks). The information can be posted on webpages, social networks, newspapers and broadcasting services.

3. Evaluation & sharing experience

In accordance with the working plan and based on selected indicators, periodic assessments and final evaluations of the efficiency should be conducted. Changes in the vegetation structure and composition have to be monitored by appropriate methods used in botanical research. It is desirable to follow the changes at least 5 years, while the long-term dynamic of some habitat types, as forest formations and dry grasslands need longer periods (up to 10 years) to display all of the effects of IAS control. The needed monitoring also could be planned in cooperation with scientific institutions or universities.

Photos of the plots before and after the eradication are illustrative and can provide direct insight into the overall achievements. When reporting to environmental authorities, these photos can be attached to technical and financial reports. For the long term support for future actions at the site, the management actions should be linked to national goals in nature conservation and sustainable use of natural resources.

Sharing the lessons learned from the implementation and cooperation on the pilot sites can be useful for other stakeholders for own successful IAS management, without making repeated and costly "try-and-mistake" efforts. It is the essence of the implemented pilots', to share experiences and show the transferability and replicability for the environmental and legislative framework of the Sava Basin.

Conveying messages from both, successful and unsuccessful actions, are of highest importance for improvements in IAS management practice and the policy development. Reporting the issues which unexpectedly emerged, like policy changes for the application of herbicides or the lack of available external service for IAS removal, are the lessons which could be useful for future efforts in the region.

Introduce your efforts to decision makers and broader public:

A storyline can be developed for different land management scenarios. If the sufficient technical data are available they can help in reasoning, how the provision of different goods and services would change in case of neglecting vs. controlling target IAS, in relation to stakeholder's needs.

4. Final conclusions

4.1.Best practices of IAS control used in the wider region

The problems caused by the established populations of invasive plants call for eradication and control measures. Eradication is possible when the invasion pathway is still controllable. For example, it is possible to put a stop to further planting of Himalayan balsam (*Impatiens glandulifera*) or knotweed (*Reynoutria spp.*) in gardens, but it is almost impossible to prevent the transport of the false indigo bush seeds (*Amorpha fruticosa*) by water during floods or the transport of flying red ash fruits (*Fraxinus pennsylvanica*) by winds in the areas containing mature populations of these species. In the cases without feasible ways to prevent the dissemination, there is the need for permanent activities to reduce the number of young IAS before they threaten the local plant communities.

When planning the eradication of IAS in protected natural areas, various conservation measures with time or space limits designed for the whole area and legally obligations should be taken into account. The overall policy should be adapted to meet the needs for maintaining the habitats invaded by IAS and for the effective protection of native species. On habitat maps, it should be clearly depicted which habitats (e. g. meadows) are degraded and not in a functional condition to provide a functional habitat for target species registered in protected areas and Standard data forms (SDF) of the Natura 2000 sites. Therefore, they should be liable to actions unrestricted by conservation measures limitations (e. g. time restrictions imposed by nesting period of target bird species etc.). When it is appropriate, it´s better not to report a degraded site as an active habitat of key species, but as a potential habitat which should be revitalized/restored. Such decision should be weighted against the facts and associated risks (e.g. land use conversion).

If IAS control is taking place on private land, a prior confirmative written statement from the land owner must be issued. When protected areas consist of many small land holds, infested by IAS, it is hard to get approvals from all land owners. On the other hand, resting of just one spot of invasive species along pathways such as a river or rivulet corridor will spread seeds and/or IAS propagules

Figure 11: Cutting knotweed (*Reynoutria* spp.) in the Una National Park.

and diminish previous efforts invested into IAS control.

Considering the applied methods, there is little or no difference between the plant eradication or control. Depending on the invasive species and the area in which it occurs, the most effective way of control should be chosen. Eradication needs to be done at least in two subsequent years. Removing IAS before May would slow down its regeneration while later removing, in summer or autumn, enables them to gather nutrient reserves in underground parts, increasing the regeneration ability.

Three broad categories cover most invasive plant control methods: mechanical, chemical, and biological. Some of the combinations of mechanical- chemical and mechanical- biological methods are also widely used.

Mechanical control means physically removing plants from the environment by pulling, cutting, mowing, mulching, girdling, digging or burning (Figure 11). In order to avoid an incidental IAS spread before and after eradication works all mechanisation and other tools should be checked and cleaned from the IAS propagules. Also, biomass infested with IAS seeds and other propagules (roots, viable stems) should be transported in closed containers and covered, to prevent accidental seed dispersal.

Chemical control uses herbicides to kill plants and inhibit regrowth. The best period for its application is spring-early summer when plants starts to transport nutrients to the roots. The policy for herbicide application for IAS management in PAs and ecological networks are different in the considered countries and sometime depend on the PA category. In buffer zones of water sensitive areas such approval is hardly to get. Foliar application (spraying the leaves) could damage the autochthonous plants in the vicinity and is only preferable for the eradication of dense monocultures, for example on closed groups of the tree of heaven (*Ailanthus altissima*). Cut stem/stump treatments by translocation herbicides kills the underground parts of felled trees or bushes, preventing their regeneration by new shoots. This treatment could eradicate even the most aggressive trees, as the tree of heaven (*Ailanthus altissima*), red ash (*Fraxinus pennsylvanica*) and box elder (*Acer negundo*). Translocation of herbicides could be also applied under the bark at the base of the tree or into drilled holes. Herbicides are among the most effective and resource-efficient tools to treat invasive species but it is necessary to follow all label precautions and other safety measures and to respect the local legislation.

Grazing is often considered as a mechanical method, but as it is much more complex than mere plant-cutting facilitated by livestock. The effects of grazing are based on complex **biological interactions,** because large herbivores are key species of ecosystems, regulating the vegetation structure and providing resources for a large number of other species. Traditional grazing is a cost-effective biological method, mainly used in grassland management, but it is also essential for the preservation of certain wetland and forest habitats. Areas permanently exposed to invasions could be controlled by regular grazing, even in cases when they are infested by species with toxic or repulsive leaves such as the tree of heaven (*Ailanthus altissima*), false indigo bush (*Amorpha fruticosa*) or knotweeds (*Reynoutria* spp.). As the seedlings and young shoots contain low levels of toxic substances, at regularly grazed areas some of these species are consumed or trampled by the livestock in early phases of their development (Figure: 12), preventing the establishment of viable populations. Grazing could be combined with mechanical methods, when the overground parts of plants are removed and the regeneration is prevented by grazing of young shoots.

In cases when the IAS seeds and/or propagules are easily transferred by grazing animals, their paths should not cross habitats of high conservation importance and IAS should be regularly checked along these paths.

The other **biological method** is based on the **competition** between plants and could be used on soils with large seed reserves of IAS in the ground i. e. common ragweed (*Ambrosia artemisiifolia*). Sowing lucerne (*Medicago sativa*) into the invaded plot creates a perennial culture which could

Figure: 12. Young shoots of false indigo bush (*Amorpha fruticosa*) appearing after mechanical treatment (left) and cattle grazing of treated area (right) (Lonjsko polje).

be mowed 3-5 times per year in the period of 5 to 7 years. In this case, ragweed appears in great number, but the frequent mowing prevents the ripening of its seeds, gradually decreasing their amount (seed bank) in the soil. In the mosaics of natural grasslands and abandoned arable plots this method leads to spontaneous grassland revitalization by immigration of grassland species from nearby natural or semi-natural habitats into the lucerne culture. As the lucerne is an excellent fodder, the method is cost-efficient and even can ensure some income.

Another method for recolonization would be the introduction of autochthonous plants by spreading hay from local meadows in a very thin layer (being aware that most of the seeds wont germinate in the darkness) on the mowed surfaces. It is recommended to use freshly cut grass, which would dry on the spot and drop seeds directly on the ground. Spreading of already dry hay bears a risk because seeds of grasses are very tiny and tend to be lost during transport.

Controlled burning may be an effective method in ecological restoration, sometimes also including the management of invasive species. As fire is one of the natural regulators of vegetation, burning requires good knowledge on the potential reactions of certain habitat types. It should be carefully applied because fire can enhance excessive spread of wood small-reed (*Calamagrostis epigejos*), native but unwanted grass on lowland meadows. Also, this method could be extremely beneficial for sprouting of invasive alien plant species like common milkweed (*Asclepias syriaca*) and black locust (*Robinia pseudoacacia*).

4.2. Field experiences of applied methods

Due to the habitat diversity of the river Sava basin, some of the gained experiences are site-specific, but most of the gathered data are considered to be valid within the broader region. Considering particular IAS eradication/control methods the most important conclusions of the project partners are:

Mowing/Mulching.

General warning: in places managed by forestry companies mowing/mulching works are subjected to national forestry legislation and will need approval from forest managing authorities. The most effective method for mowing herbaceous IAS is before its fructification (if possible, before blooming, decreasing the development of underground parts, too). Extraction of woody IAS must be carried out before its seeds are rippen. In

order to lower the survival IAS rate or chance for its reemerging after mulching, it is recommandable that plants remaining on sites inaccessible to mechanization should be hand-pulled. Also, the combination of mowing/mulching and grazing is strongly recommendable. Combined eradication practices should be applied at least twice per year.

Experiences with particular IAS:

1) ***Impatiens glandulifera***: Potential risks include possible harm for vegetation and erosion of stream bank caused by mulching and pulling out invasive plant individuals. These risks appear to be less pronounced at habitats with tree cover where not much sensitive vegetation grows. Also, some plants damaged during mulching tend to regrow or they even bloom so the mulched area should be monitored after mulching and appearing plants should be hand pulled.

2) ***Solidago* spp**. Mowing and mulching are recommended to prevent growth of goldenrod on meadows or where plants are present in lower numbers. With these methods the eradication of goldenrod is slower but less harmful for native plants. This method proved to be highly effective on lowland meadows in Odransko polje (Croatia) where the giant goldenrod (*Solidago gigantea* Aiton) significantly decreased in number.

3) ***Amorpha fruticosa***. Mowing/mulching alone has proved to promote aggressive regrowth of new plants across newly opened areas from remainings in the ground or near the ground and from the seed bank. Also, some other invasive alien plants (e.g. *Bidens frondosus*, *Erigeron annuus*, *Solidago gigantea*) started to grow after the shading tree and bush species were removed. On the one side this created s low dense shrub layer which could be controlled with much lighter machinery at five times lower costs (but still needs money!). But, quick resprouting from remaining plant parts and a lot of remaining biomass can impede later mowing efforts. Consecutive repetition of mulching is possible but it is not effective and it is considered as too expensive.

4) ***Asclepias syriaca***. A month after mulching, first young plants emerged (occasionally 1-2 stems from one root), but the total number was low. This method appears to be the fastest and most economical in large areas, but it usually only removes aboveground plant parts while thick rhizomes, containing nutrient reserves, remain more or less intact in the ground, so young plants can quickly resprout.

Hand pulling

This method is particularly recommended on sites with greater number of native species and areas where invasive species are at an initial stage of invasion or in places inaccessible to mechanical removing.

Experiences with particular IAS:

1) ***Impatiens glandulifera***: hand pulling can be hampered by far-reached position of target plants (e. g. within the stream). Many small plant parts (shoots, young stems on the ground etc.) remain hidden within dense vegetation and grow later on. In the case of hand pulling, repeatitions more than once a season and the combination with mulching (mulching with hand-pulling later) is highly recommendable. Potential risks include erosion caused by pulling out invasive plant individuals.

2) ***Asclepias syriaca***. Powerfully developed tuberous rhizomes, by which plants quickly forms new colonies, are hard to completely remove from the ground by hand-pulling. Only a month and half after the initial removal of aboveground plant parts, even the smallest remaining parts of rhizomes start to emit new offshoots and new plants quickly recolonize the area again. Moreover, this method is hard to apply in larger areas and as it needs to be repeated many times it is economically not sustainable in the case of this species.

Milling by rotary hoe/cutter

This method destroys the entire vegetation, leaving an open soil surface that needs further management actions. It is only moderate successful in the cases of invasive plants which are able to regenerate from very small (less than 5 cm long) underground shoots.

Experiences with particular IAS:

***Solidago* spp**. Milling is most effective at dense stands with not so much native vegetation. After milling, sowing of native plants seeds is recommended to prevent colonization of the area with other invasive alien plants.

Mechanical pulling

Experiences with particular IAS:

Ailanthus altissima. Using extractigator for pulling trees of heaven out of the ground can be effective while trees are still young and did not yet developed an extensive root system. This method is recommendable for elimination of smaller number of young trees.

Herbicide treatment

Herbicides are among the most effective and resource-efficient tools to treat invasive species but it is necessary to follow all safety measures and to respect local legislation. Also, its application should not be considered in places close to water bodies (e.g. ponds, lakes, rivers, flood reservoirs). The main disadvantage of this method is that it requires a longer period of work, a large number of engaged human labour and its efficiency depends on how well and detailed each plant´s surfaces of leaves and stems are painted. This method is not feasible on large areas but can be applied by a small group of people on smaller areas inaccessible to mechanization. Also, herbicide treatment can be obstructed by local public opinion, which is shaped differently in highly invaded sites compared to areas with still well preserved nature, where local people have not faced losses caused by invasive species („do nothing and nature will solve itself“).

Experiences with particular IAS:

1) ***Solidago* spp**. The best results are achieved on homogenous *Solidago* stands without much native plant species, where this method proved to be most effective in combination with mulching.

2) ***Asclepias syriaca***. Herbicide painting has proved to be a quite effective method of elimination with a success rate of 40-60% and no new plants emerging after treatment. However, this method should be applied with exceptionally care (only manual treatments localised on the IAS specimens) in areas close to the water bodies and in initial stages of invasion i. e. in habitats with natural vegetation.

Grazing/Browsing

Experiences with particular IAS:

1) ***Amorpha fruticosa***. Eradication of *Amorpha fruticosa* is cost effective only when grazing can be ensured. The pasturing method gave the best results in cotrolling *Amorpha fruticosa* but other fast-growing invasive or pioneer species, which are avoided by cattle like *Bidens frondosus*, *Xanthium strumarium* and *Polygonum lapathifolium* can create big problems for the revitalization of grasslands. It is strongly recommended to combine pasturing with mowing/mulching after mid August. In other cases it will resprout up to two meters high after only four months - making invested money wasted money.

2) ***Asclepias syriaca***. Grazing by cattle is not possible since *Asclepias* is not palatable.

3) ***Reynoutria* × *bohemica***. Contrary to the international experience removal of young knotweed plants and offshoots by goat browsing could not

be implemented since the goats didn´t want to eat them. Effects of grazing in IAS control, by the same grazing species, can be different and shaped by local environment and previous grazing habits of the utilized cattle.

4.3. Experience from planning and organization

- Proper planning of IAS eradication can target several species with the same method and the same action. This depends on the biology of the target species and the vulnerability of native species/habitats which are to be cleaned or revitalized;
- Defining efficiency indicators is very important to make reasonable and correct conclusions on the IAS eradication/control effects. For long term impact evaluations, both, physical and economic parameters are necessary to be monitored throughout the implementation;
- Control of the IAS on the highly valuable habitats and species is the top-objective in nature protection, but also other land management objectives can be addressed by appropriate method (example: the revitalization of an oxbow invaded by IAS at pilot site Obedska Bara where results of IAS eradication rejuvenated the wetland/water habitat and increased capacity for nature based tourism and recreation like canoeing or fishing);
- There are possibilities for co-financing from other sources when addressing other land management needs (also in the above example of Obedska Bara);
- Removing and controlling IAS from pathways and vectors is crucial, particularly if the IAS are scattered or found at their initial phase of invasion (look at the annex Pilot report Ljubljansko Barje);
- Herbicide application for IAS control can be controversial. Even when applied in strictly controlled and sellective method (injection into the target IAS), sometime is getting misjudged by the local communities, and compared with effects from large-scale and non-selective usage in agriculture;
- Collaborative work on IAS control (removal, monitoring) with volunteers from youth camps, the business sector (team building) and similar crowding events can be cost-effective and might have potential to make a significant and long term impact;
- Eradication efforts can reveal potential conflicts with nature conservation policies, land management and nature protection issues (e.g. bird nesting and honey production; earthworks on tourism hot-spots);
- Issuing official approvals from higher authorities for actions on IAS eradication (mowing, herbicides, soil works) on target sites positioned within protected areas can be hard due to complex and sometimes overlapping ownership and nature management issues.
- Make sure that your management plans (of the PA or other ecologically important areas) and plans from the natural resource management (e.g. forestry, water authority) allow for IAS eradication actions and if not, establish a framework on how it can be managed;
- When contracting external service for works, the contract must thoroughly define all technical details concerning what can be expected from the contracted service (e.g. not only tools and timeframe, but also where and on which way the infested soil or mulched biomass or hay will be temporary or permanently deposited);
- Be ready and plan risk mitigations during the implementation, as floods and other natural, economic or health circumstances can rearrange the time and resources you or your external service have planned to engage in for IAS control. Without a flexible approach,

the actions on Odransko polje and Lonjsko polje wouldn't have been implemented.

- For the long term and for cost-effective control of IAS on target sites, the presence of IAS must be monitored annually, particularly along ecological corridors and other pathways, on nearby regularly disturbed sites and similar structures (e.g. linear infrastructure, forest clear-cuts, riverbanks, landfills);

- Exchange experience with other PA mangers in key implementation phases, from the planning to disseminating;

- Provide media coverage, make short videos, take photos from implementation for documentation;

- Inform the wider public and promote your results to both local and higher instances, emphasizing how the implemented activities added values of social-economic concern in relation to preserved nature.

Some of the project partners will continue selected IAS control in the future. It is also worth to keep on with the monitoring, because some effects of the applied methods will be displayed well after the closing of the project. The end of the Sava TIES project doesn`t mean the end of the activities at pilot sites. Continuing the IAS-control activities on the transnational scale is needed for effective control of invasive plants in the Sava River Basin.

List of annexes

1.) Template for Pilot planning used in the Sava TIES pilots

2.) Table overview with all sample plots on the 7 protected areas

3-9.) Final pilot reports from the implementing partner organisations

This project is co-funded by the European Union funds (ERDF, IPA)

Annex 2

Overview of dataset for the 7 implemented pilot actions

	JZ KPLB s1	JZ KPLB s2	JZ KPLB s3	LPNPPI	Zeleni Prsten	NP UNA	CZZS	NCMSM	VSUME
Site name	**Nature reserve Ribniki v dolini Dragi pri Igu**	**Rakova Jelša**	**Škofljica**	**Osekovo**	**Odransko polje**	**Kulen Vakuf**	**Tišina Bara**	**Zasavica**	**Krstonošića okno**
GIS location (WGS 1984)	45.932334, 14.548666	46.021403, 14.494786	45.977432, 14.564201	Osekovo west, S 45°30'07,66'', I 16°35'17,88''	45.650755, 16.225006	44°33'43.46N 16° 4'55.97"E	45.041308, 18.502265	44 56-54,30 N 19 31-07.08 E	44.729829, 19.987714
Habitat type(s) EUNIS	Sub-Atlantic lowland hay meadows (E2.22) and tall-herb forest edges	Tall-herb comm. of humid meadows E5.421	Moist or wet eutrophic and mesotrophic grassland (E3.4), Lowland tall herbs (E5.4)	D.4.1.1. / A.4.1 / C.2.4.1. Amorpha fruticosa stands / Reedbeds and large sedge communities / Nitrophilous flood swards	E2.22 Sub-Atlantic lowland hay meadows	Meadows, Karst and other Subterranean Inland Aquatic Systems	G1.111 Middle European Salix alba Forest, C1.1 - Permanent oligotrophic lakes, ponds and pools	3150 Natural eutrophic lakes with Magnopotamnion- or Hydrocharition, 6440 Alluvial meadows of river valleys, 6510 Lowland hay meadows	Wetland, swamp, pond
IAS	*Impatiens glandulifera*	*Ailanthus altissima*	*Solidago gigantea, Solidago canadensis*	Amorpha fruticosa, Xanthium strumarium	Amorpha fruticosa, Asclepias syriaca, Reynoutria x bohemica, Echinocystis lobata, Aster lanceolatus, Ambrosia artemisiifolia, Impatiens glandulifera	Reynoutria x bohemica	Amorpha fruticosa, Acer negundo, Echinocystis lobata	Asclepias syriaca	Amorpha fruticosa, Ceratophyllum demersum,
Eradicat. method 1	Mulching	Pulling with extractigator	Mulching, mowing	Mulching, mowing, fencing	Mulch mowing	Mowing followed by herbicides injection (Glyphosate, Garlon 3A)	Mowing, trimming, cutting, girdling, aforestation.	Mechanical - hand pulling Mechanical – rotating cutter	Uprooting of Amorpha with the soil layer (rhizosphere), rejuvenating the oxbow.
Eradicat. method 2	Hand pulling		Using rotary hoe for milling	Mulching plus grazing, fencing	Mowing	Digging		Herbicides painting	/
Eradicat. method 3			Applying herbicide with weed wiper	Fencing (for the later spontaneous development)		Smothering-Covering by nylon			/

Equipment type	Hand gloves		Motocultivator, rake (from other resource)	Electric fence, contracting external service (tractor with mulcher)		Hand tools, specific chemicals, appliances	Hand tools	Hand tools, tractor with mulcher, small truck for transportation of removed pants	Mechanization/ bagger
Indicator(s)	Difference in cover of *I. glandulifera* and number of plants in quadrants between years	Presence/absence of eradicated trees	Difference in cover of the *Solidago* and number of plants in treated quadrants in comparison with untreated ones	IAS cover VS cover of autochthonous sp., corncrake, black and white stork	IAS cover VS cover of autochthonous plants; the corncrake presence	IAS cover VS cover of autochthonous species	IAS cover VS cover of autochthonous species	IAS cover VS cover of autochthonous species	IAS cover VS cover of autochthonous Birds presence: Platalea and Plegadis
Monitoring method	Cover of *I. glandulifera* in 10 quadrants (1 m x 1 m) was estimated and specimen in the quadrants were counted every spring	Pictures of the place where were eadicated	Cover of *Solidago* in 24 quadrants (1 m x 1 m) was estimated and specimen in the quadrants were counted every spring	Presence/absence - list of indicator species photos	Regeneration of the meadow vegetation photos	Long-term monitoring (4x per year) and management.	Density of IAS before and after eradication	Density of IAS before and after eradication	Cover values of not-IAS species(%)
Eradication expenditures in application (EUR/ha)	1043,31 €	427,00 €	219,00 €	Total costs: 1.550,00 € + VAT Mulching: 1000 €	25.800 € (external services - overall price for eradication and monitoring)	1.635 € per 0,01 ha for works and monitoring (cost of the equipment is not included)	2,4 ha area: habitat mapping, eradication, monitoring, preliminary research, afforestation, maintenance – costs: 29.810 € (12,421 €/ha)	Hand pulling= 200 € Mechanical – rotating cutter = 590 € Chemical removal = 180 €	30.000 EU€R
Equipment costs	0	0	0	Eletric fence 1.605,00 € + VAT	0	0	0	0	0
In-kind field activities (monitoring, manual work); engaged volunteers (days/ar or days/ha	Manual work: 10ppl (pupil volunteers) /1day, 4 ppl/2 days, 1prs (person)/2 days Monitoring: 2 ppl/1 day, 1 prs/3 days, 1 prs/2 days	1 prs / 3 days, 1 prs / 1 day	Work: 5 ppl / 1 day 4 ppl / 1 day 3 ppl / 1 day 3 ppl / 1 day Monitoring: 2 ppl/ 1 day 1 prs / 2 days	Monitoring (own staff 3 employes / 5 days), Electric fence-fencing and removal (own staff 4 employes / 2 days), control over the contract implementation (own staff 2 employes /11 days) 4,5 days/ha		The project staff spent 15 days in the monitoring and fieldworks.		Monitoring and the manual IAS treatment was performed by own NCMSM staff (20 days)	The staff spent 55 working days in pilot planning, supervising the fieldworks and monitoring.
Challenge/ Risk mitigation	Volunteers not able to help with eradication due to COVID-10 pandemic / Project staff members took over.	We were not able to find external service for herbicides injection. / The method was changed to pulling out.		Biobaler service cancelled the contract. / Method changed, from the bioballer to mulching/ mowing	Conservation policy conflict, between bird nesting and the IAS removal. / The fieldworks postponed to period after the bird nesting	Goats did not want to browse the knotweed shoots. / Method change, from goat browsing to smothering by nylon sheets.	We planned volunteers work for eradication –not allowed by BiH FLC to cover the costs (refreshments etc.). / The eradication works had to be implemented as external service.	Risk of polluting river by pesticide / Herbicides were applied at the stem of each individual by painting to avoid pollution	The flood postponed the fieldworks.

This project is co-funded by the European Union funds (ERDF, IPA)

Annex 2: Sava TIES Pilot planning Template

Full name of Project partner (PP):

Site name and center point GIS location (in WGS 1984):

Habitat type of the pilot area (EUNIS level 3 or more detailed, including the name in English you prefer to use, i.e. not only the code):

Habitat sensitivity: e.g. closer then 10m to water habitat, pollution risk if pesticide is sprayed.

Target invasive species (Scientific and English name): one or more...

Method of testing effectiveness of treatment of invasive species: e.g. Mowing in May, afterward grazing cattle. Notes on days in farming and number of cattle per hectare. expected number of cattle/ha EG: density of cattle: 5 cows/ha in first season (or which density)?, after initial on-purpose over-grazing to suppress the IS, will be decreased to 2 cows/ha. OR for Impatiens sp.: Pulling out by volunteers guided by the PP expert, repetitively if needed. Noting number of engaged activists, spent days of active work on exact dates and area cleaned.

Background and rationale: why you have selected that/those species and the applied method (two-three sentences in brief): e.g.: The Ailanthus was selected because it is in the initial phase of invasion, when the species can be eradicated cost-efficiently. OR: Reynoutria (Falopia) because it pose the main threat to the biodiversity in the "ZZ" protected area. For the method: ... was considered to be most appropriate for the area (close to river-risk of pollution or cheap/ fast results).

Initial mapping of the pilot area(s): cover (%) of the invasive species (targeted and additional if there) on the site. For Amorpha planned for biobaler, mapping polygons of grasslands in 4 categories of Amorpha biomass density (no Amorpha, low, medium, high) and its' thickness (thin, medium or thick stems) based on free satellite images and photos of pilot.

Equipment for eradication: e.g. hand tools, contracting third party for mowing, specific chemicals, appliances (injector for pesticide), biobaler renting, transportation of volunteers. For pesticides: Please consider you might need special permission from nature conservation authorities in case of protected area! also check the list of permitted pesticides in your country (responsible is Ministry of agriculture).

Indicators for monitoring effectiveness of eradication: initial cover (%) of the invasive species (targeted and additional if there) on the site, number and cover of survived specimens of the target IAS, post-treatment cover (%) of the IAS, quantity of valuable species (birds, plants etc.).

Monitoring plan after treatment: e.g: taking photos twice a year on the area (Fallopia and Ailanthus after injecting herbicide); OR quadrants with species list and cover values or polygon mapping.

Key Stakeholders: e.g. forest manager, cattle herder, bee-keepers, conservation agency...

Expenditures (€) of the different alternative tested eradication methods: nominal cost of provided on-field tools and equipment, travel cost calculated on rate 0,22 €/km, shepherd allowance, mowing cost, days of staff spent on planning and monitoring. At the end of project, cost can be summarized in direct cost (real investments in equipment, cattle herder allowance,

external expertise in monitoring), and descriptive one (days of volunteering and staff involvement as in-kind).

Risks and risk mitigation regarding the accomplishment of the Pilot plan: e.g. if grazing on the site can not be achieved, what are the alternatives? Mowing? Spraying with pesticide? Defining new sample plot?

Timeline with Milestones:

Tasks	Reporting period								
	I		II		III		IV		V
	Milestone 1 Pilot plan prepared		Milestone 2 Sample plots established		Milestone 3 Eradication & Monitoring 1		Milestone 4 Eradication & Monitoring 2		Milestone 5 Final Report
Pilot planning	First half	Second half							
Equipment issuing									
External services (subcontracting)									
Eradication activities									
Monitoring									
Stakeholder involvement									
Evaluation of results									
Reporting									

This project is co-funded by the European Union funds (ERDF, IPA)

Plan of expenditures:

Expenditure	Monetary cost (€)		Descriptive (non-monetary quantified)	Non-monetary compensation options
	Unit	Total cost expected	(e.g.: man/days)	
Equipment e.g: Fencing the area (if necessary for controlling the pressure of cattle)	e.g.: 10 €/m of fence	e.g. 500 €	e.g.: 2 man/days (which means that two men worked for one day or one worked for two days)	
Labour/Volunteers e.g: Shepherd allowance	Days of farming (from-to, might be more than one continual period).	e.g. 500 €	e.g. 10 days (Working days of volunteers, Staff or other descriptive like "In kind")	e.g.: Shepherd is pasturing the area for free in compensation (free of fees for renting pasture compensate the shepherds' allowance).
Monitoring			e.g: 5 days/ year OR 3 hours/week during 5 weeks/year	
Overall budget for pilots/ budget for monitoring				

Supplementary 1: Google image of the area with sketched polygon of pilot (the one you already provided in the Questionnaire)

Supplementary 2: Photos indicating IS cover before starting eradication (on spring, no later than 1st June)

REPORTING PLAN

The Pilots' implementation is going to be reported in accordance to the SavaTIES workplan. At the end of each of DTP Sava TIES reporting periods (including I, II, III, IV and V reporting period), achievements on the pilot implementation will be reported to the Lead Partner and Coordinator of the Work Package (WP 5).

The reports during the pilot implementation will include the following data:

- executed fieldwork activities (descriptive summary, incl. maps, pictures),
- monitoring (dates of monitoring, data and photos with brief description),
- impediments in pilot implementation (natural and anthropic),
- eventual reasoned changes in the original plan (mitigation after unexpected event, e.g. flood on sample plot),
- involvement of stakeholders,
- eligible costs,
- eventual cost in activity implementation which were not foreseen or not eligible,
- other relevant data from the project implementation.

The final report on the each pilot activity will provide more detail information on biophysical results presenting the efficiency of the methods and costs made on pilot implementation, as two keystones for Joint Final Report (output cc). It will include:

- complete overview of the costs (EUR /hectare, time investment / hectare), per budget lines (staff, external services, infrastructure, equipment),
- biophysical data obtained from monitoring,
- conclusions on effectivity of the pilot action and
- recommendations based on the experience from pilot implementations (what in future actions should be considered in addition).

The pilot action should be revised and adapted if proves to be not implementable or brings counter effects.

Joint Pilot Report and Transferability Plan of the Sava TIES Pilot activities in IAS management

Interreg

EUROPEAN UNION

Danube Transnational Programme

Sava TIES

This project is co-funded by the European Union funds (ERDF, IPA)