

Lessons learned – 3rd reporting period

Management, financial reporting	The work that needs to be invested for the administrative work can be overwhelming for small organisations (2-3 employees). Delegating the management and financial reports to the administrator can help the experts focus on the content.
Citizens engagement/ awareness raising	Raising the awareness of the general population takes its time. We realized that after three years, knowledge of IAPS and their use is better. However, such activities should continue in order for IAPS harvesting and their reuse to become a habit of the citizens.
Diverse consortium	Through interactions with different project partners, it is evident, how the different expertise and the wide range of equipment and methodologies of partners working together, can speed up the process to produce useful results faster.
Organization of work	The traditional way of making paper is done by old machines and devices. It turned out that old machines need more service than expected.
	Alternative/independent production facilities need to be planned in advance to ensure the production of desired outcomes in case of unpredicted events.
Selection, harvesting, pre-preparation, primary wood processing	A lot of felled woody IAPS were small dimensioned and therefore were not usable for big saw mill and big production of wooden boards. Also, lots of branches of cut woody IAPS could be used for small wooden products, but need different approach as planned.
Research	The use of waste biomass - lignin, dyes and polyhydroxyalkanoates - can be extremely diverse. Waste material can be used for the production of hybrid coloured coatings for glass and wood, natural dyes and as a source of various useful chemicals. During the APPLAUSE project and while working on it, we discovered that we can produce and process many useful things from waste materials and natural resources that are cheap and easily accessible.
	Even though IAPS extracts were tested as home-made preparations against harmful organisms, their sterilisation is needed because plant materials contain diverse endo and ectophytic organisms which can infect extracts and alter their antimicrobial activity.
	Several different IAPS materials should be tested at the beginning of the project to obtain as much information as possible about their potential availability and applicability. In the following steps, we narrow down the selection of species and explore more targeted. With initially limited number of species, that were used in the project (list of IAPS made in advance), we increased the possibilities to achieve positive results.

	<p>Dyeability of cotton and polyamide with water extracted dyes from staghorn sumac drupes and goldenrod flowers is higher at lower dyeing temperature, hence it is not necessary to use energy for heating dyebath, which adds additional ecological benefit of using IAPS dyes for dyeing textiles.</p>
	<p>Papers made from goldenrod and black locust cellulose are good for inkjet and screen printing and less for UV printing due to the ink wicking and the associated contrast of printed image. Regardless of printing technique the most heterogeneous prints were achieved on paper made from goldenrod cellulose.</p>
	<p>After characterizing the physiology of the isolated bacterial strains, we now better understand the complexity of bacterial metabolic pathways and the importance of different environmental factors that affect these pathways. We can better predict the difficulties that the development of biotechnological solutions will bring in the laboratory and the up-scaling process.</p>
	<p>Based on the laboratory and pilot production testing the use of invasive plant paper is suitable for analogue printing technologies like offset and flexo as well for digital printing technologies (electrophotography) and partly for office type ink-jet printing. The surface sizing in combination with the fibres provided good printability values regarding optical properties, except for inkjet due to absorption of the dye in the structure as for all uncoated papers.</p>
	<p>In converting the gluability due to a lot of open pores was good, while cutting on a table cutter posed some problems most probably due to irregular fibre bonding and formation. Laser and die cutting due to different motion/type of ablation posed no converting problems.</p>
	<p>When laminating 3-5 sheets of paper with water-based glue, paper tends to wave. Before any conversion is done, the paper needs to be in the same conditions as the converting process will be carried on.</p>
	<p>All the broken paper and paper from failed production can be used again with no influence on the final paper properties.</p>
	<p>Research processes vary greatly among diverse partnerships. Defining, recognising and evaluating methodological frameworks across disciplines is crucial when working in interdisciplinary environments.</p>
	<p>Wider list (not only eight species) of plant invasive species could be selected for testing against plant harmful organisms. This way, we could easier find the most effective home-made formulation against plant harmful organisms.</p>
	<p>As we have assumed, higher efficacy of home-made formulations from plant invasive species can be achieved by combining them with other alternative plant protection methods.</p>
IT, digital platform, database	<p>Plan costs for software support from the moment you start writing Application form and make sure you have a budget also for testing period which can happen also after the end of the project when project costs are no longer eligible.</p>

<p>Wood products prototype and production</p>	<p>It was planned only to provide open data of plant types, which were analysed within the APPLAUSE project. It was clear after put in the production, that also data on other plant species are required. In the future, we will always plan to interconnect as much data as possible. It does not make much more expense, but offers more analysis and pre-processing also in other work related to IAPS.</p>
	<p>We applied deep learning approach for object classifications - it is most popular and widely used approach today in artificial intelligence (AI). Open source algorithms did not manage to handle well plants similarity. Plant recognition results were not satisfying enough. If we will re-do the application in the future, we will do pre-selection of the AI approach more in detail and better understand experts' approach to the process of plant identification. We will not be focused on the deep learning technique only.</p>
	<p>When identifying different types of invasive species using satellite imagery (Sentinel-2), it is important to have a consistent set of terrain/field data for relevant time series analysis. This means that sufficient field data should be available for analysis to provide good results and that the stands of invasive species are large enough to be visible on the satellite images (the stands should not be too small).</p>
	<p>Terrain/field data of populations of many invasive species (e.g. tree of heaven (<i>Ailanthus altissima</i>), cherry laurel (<i>Prunus cerasifera</i>), staghorn sumac (<i>Rhus typhina</i>)) are too much mixed with other vegetation to obtain relevant results with automatic detection from satellite images. Mixed pixels are the reason for a much lower classification accuracy.</p>
	<p>It is also important that the terrain data are obtained for the whole study area and not only for a part of the area. The spatial arrangement of the terrain data leads to a greater homogeneity of the sample data and can lead to better detection results over the entire investigation area.</p>
	<p>The whole production of wood-plastic composites turned out as a new challenge. From selection of material, its particle size to finding the best ratio of wood and plastic, best parting agent, construction of moulds and geometry of final products. With several modifications and repetitions, we managed to obtain a functioning recipe for WPC production.</p>
	<p>While working on the activities regarding the surface treatment of woody IAPS a special attention must be paid on the proper selection of the coating material. The selection of coating material does not depend only on the required properties and final visual appearance, it must be also compatible with the wooden substrate. Not all types of coating materials or varnishes are appropriate for all woody IAPS. A certain type of coating can cause a diffusion of extractives into coating film, whose visual appearance and other properties can be altered accordingly.</p>

Communication	Through the dissemination of project activities and results, as well as the situation caused by SARS-CoV-2 epidemic in 2020, we conclude that higher education (including scientific fields of chemistry, physics and biology) should be communicated to a wider extent and through different media actively by the government in order for the general public to follow the fast growing scientific developments.
Circular business model	Within the self-sufficient business model, which is the output on WP7, we realized that the selected activities of different partners have the potential to operate when project ends. The challenge is how to connect and organize informally these partners in order to achieve the desired synergy effects also in project afterlife.
	Products and production lines act as enablers of practices that activate around them. If we want to set common circular business model(s) we need to agree on desired goals and values upon which we want our model to work.