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Theses of doctoral (PhD) dissertation

The role of road-environment, influencing the spreading of impact-factors, on natural areas

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1. Actuality of research matter, aim

One third of Hungarian territory is natural area respectively protected natural area, and almost all forest can be listed here. Roads being built and can be found in this kind of areas, environmental impact factors of their traffic endanger natural values, close-to-nature state of areas. Real damage can be occurred in impact area. Impact area size depends on characteristic and volume of impact factors, and impact affecting ability of road-environment too. Impacts occurring on the roadsides starts different impact processes in affected environment and on its impact wearers, which flowing is considerably determined by environmental characteristics and facilities.

The aim of research is to determine impact forwarder mediums as well as their characteristics which affect dispersion. The more exact we know impact forwarder and constrain elements as well as processes passed on impact area, the more we can determine dispersion distance. These data will help to decrease harmful effects of roadside impact factors effectively. Further aim is to make a checking list for impact environmental impact assessment concerning to range. According to author's examinations, during making of an impact assessment researchers do not turn proper attention to limitation they only give general values for range. Her aim is define road-environment types affecting dispersion differently, ensuring further help for one of important step of impact assessment, which is impact area limitation.

In order to fulfil the research aims, among others, impact factors occurring in the different phases (establishment, operation, abandonment) of the roads must be examined. Those characteristic, quality of affected environmental elements and impact wearers must be investigated. More detailed from them, which take part in dispersion. Conformity with these road-environmental characteristics affecting different emission extensions must be considered.

2. Hypotheses of research

1. Different impact factors can be observed in various phases (establishment, operation, abandonment) of roads, which importance varies as a function of effects caused by them.
2. Impact processes owing to impact factors directly and indirectly result changes in quantitative and qualitative characteristics of affected environmental elements and impact wearers. Dispersion can be concluded by shadowing of changes.
3. Dispersion area, which is identical with impact area, depends on impact constraint ability of road-environment, on those road-environmental characteristics which affect extension each impact factor. Guide numbers can be given for extension of the most important impact factors, which help realization of environmental impact assessment.
4. Impact constraint ability is in relation with sensitivity and loading capacity of impact wearers. Based upon these, different road-environment types can be determined in the aspect of impact forwarding. Impact forwarding of impact wearers of road-environment can be characterised by guiding numbers.

3. Research methodology

In the interest of research success, the author applied the following methods:

- Literary research

On investigation, author adapted several foreign (English, German) and Hungarian specialized literature. Most of specialized literature looked across generally deals with impact assessments. Within this, sections related to impact areas, impact extensions and range are quite incomplete.
During my study, analysing of assessment fills an important role. In Special library of Environmental and Nature Protection and Water Authority, author process almost 100 types of impact assessment for roads and summarized statements for impact area. Concrete figures concerning to dispersion was found in 30% of impact assessments. Process results illuminated value incompletion related to range of each environmental element.
Result of related research executed in the University also provides important starting base.

- Impact area assessments on aimed pattern area

Examined establishment can be found in the Bakony Hill, area of Farkasgyepü. Iharkút-Szamárhegy 2nd class, exploit-route, on which bauxite transportation carried on besides forestry purpose. In 2003 and 2005, author repeated surveying of plants can be found impact area of the road. Base of surveying was species list measured within impact assessment dated on 1999. Soil examinations also happened in 2003 and 2005. On the one hand, these examinations are marked out for providing of verification of hypotheses related to dispersion, because sampling places are situated defined distance from the road. On the other hand they help to determine road-environmental types.

- Laboratory tests

Soil samples were analysed in Soil Science Laboratory of the University. During investigations, those parameters were highlighted, which can be varied as a function of traffic impact factors on the roads and them. On one hand they concern to soil pH value, on the other hand they concern to metal content

4. Theses

1. *Different impact factors can be observed in various phases (establishment, operation, abandonment) of roads, which importance varies as a function of effects caused by them.*

Roads, as impact factors of track establishments were examined according to life cycles applied in environmental impact assessments. It was proved that impact factors appearing constantly and long term in dispersion analysis of operational phase mean proper base. Besides, each impact factors of establishment phase has important effects, which can cause irreversible changes. Such area conquest as well as direct removal of vegetation, construction and excavation works needed for road construction. Essential impact factors of operational period are various forms of air pollution resulted from traffic and pollutions from maintain works. The above mentioned impact factors mostly damage quantitative and qualitative facilities of soil and living world, what is favourable from that aspect that, changes resulting in these environmental elements can be tracked well.

2. *Impact processes owing to impact factors directly and indirectly result changes in quantitative and qualitative characteristics of affected environmental elements and impact wearers. Dispersion can be concluded by shadowing of changes.*

Because author examined on natural areas far from inhabited area, and as road is forestry exploit route, so I generally examined operative establishments, human and land as impact wearers. Those environmental elements, with which changes must be calculated: soil, air, water (surface and underground) as well as living world (flora and fauna). Owing to each impact factor, concerned elements pass through quantitative and qualitative changes. In case of air and surface waters, effects causing mainly qualitative changes generally show sooner, because they are easily changing systems, so we can tell that their impact forwarding ability is rapid.
The most important impact factors endangering air quality: traffic, gases emitted during transportation, metal polluters, dust, abrasive products. In the course of improper culverts, water installations including dissolved or current pollutions flowing down from the road, surface water can damage.
On the one hand, underground waters change by soil pollution, on the other hand by considerable landscaping. Their impact forwarding ability depends on connection system among different underground water formations. If a given pollution gets into a closed water system without connection, impact forwarding comes to an end. But an extended network can considerably increase the impact area.
In case of the soil, quantitative and qualitative changes occur alike. Quantitative relations can modify in establishment phase, while quantitative facilities can change in all of road phases. Soil can be contaminated directly, by pollution flowing away or transmission of other environmental element (e.g.: water, air). Generally it can be proved that slower processes are typical for soil impact forwarding ability as a function of pollution characteristic.
Examining the living world, it can be ascertained that in most cases, quantitative changes must be calculated, because qualitative modifications (which generally mean decline) result quantitative modification too. In the animal world, each effect exceeding a threshold (e.g.: increasing noise level) results a fast response reaction (e.g. migration). In the flora, slower resulting changes can be seen, impact forwarding requires more time, they characterized by quite slower processes.

3. *Dispersion area, which is identical with impact area, depends on impact constraint ability of road-environment, on those road-environmental characteristics which affect extension each impact factor. Guide numbers can be given for extension of the most important impact factors, which help realization of environmental impact assessment.*

Soil
Its most important characteristics participating in impact forwarding are: base characteristics of the soil (e.g.. pH, constraint, humus content), water-layers arrangement, natural heavy metal content, inclination to sour or alkali, land slope, physical and chemical parameters of current pollution.

Guide numbers of dispersion in case of typical impact factors:
- area conquest: full length of establishment, as well as maximum 100m from axis line;
- earthworks: full length of establishment, as well as maximum 20m from axis line;

- water constructional works: if network of trenches can be found along the establishment, then full length of establishment and maximum 2m track on left and right side can be considered as impact area;
- emissions (dust, waste, air polluters): - 1-50 wide track from axis line left and right side, to 5-50cm soil depth;
- establishment maintenance, chemicals, salting: 2m wide tracked measured from pavement edge right and lift side;
- traffic, material emissions: heavy metals left and right side in 30-50 wide track, to 5-50cm soil depth; within this lead is to 20-30m, to 20-25cm soil depth;
-average: 1-200m from axis line right and left side;

Surface and underground water
Its most important characteristics participating in impact forwarding are: in case of surface waters, current size, water output, size of water source, speed, coastline characteristic (natural-artificial) are influential. In case of underground waters, filterability of soil layers above water sources, layers sensitiveness, and stability are important. In both cases physical and chemical characteristics of pollution are important.

Guide numbers of dispersion in case of typical impact factors:
- area conquest: this mainly affects subsoil water, full length of establishment , maximum 15m from axis line right and left side, to 0,5-1m depth;
- earthworks: it affects subsoil water in full length of establishment, maximum 10-15m from axis line right and left side, to 1-2m depth;
- water constructional works: led reach of living water flow crossed by establishment belongs here, as well as, if network of trenches can be found along the establishment, then because of subsoil water disturbing, 5-100m track, right and left side, full length of establishment can be considered as impact area;
- emissions (dust, waste, air polluters): effects concerning to subsoil water can probably be rendered within 10-100m track, getting into living water increases the impact area in the direction of water flow;
- establishment maintenance, chemicals, salting: effects concerning to subsoil water can probably be rendered within maximum 15m track, getting into living water increases the impact area in the direction of water flow;
- traffic, material emissions: in case of heavier traffic roads, pollution can be calculated along the line in 100-100m track; in case of inferior roads pollution can spread in 10-15 m track, to 2m soil depth;
- average: 1-200m track from line;

Air
Its characteristics participating in impact forwarding are: direction and strength of ruling air movement, atmosphere stability, diffusion, atmospheric inversion, surface characteristics of examined area, quantitative and qualitative (physical, chemical) facilities of emitted air polluters, roadside edges.

Guide numbers of dispersion in case of typical impact factors:
- pavement building: full length of line, 10m track from pavement edge right and left side alike;
- material transport: full length of line, 100-150m track from pavement edge right and left side alike;
- maintenance: full length of line, 5-10m track from pavement edge right and left side alike;

- traffic: air pollution is harmful for human health within 30-150m track, but it can be loading within 30-500m track;
- average: 1-200m track from line;

Living world
Following characteristics affect impact forwarding to the highest degree: biodiversity, isolationess, population extent, tolerance, association types (composition, levelness, and extent), state of health, age, roadside edges.

Guide numbers of dispersion in case of typical impact factors:
- area conquest: full length of establishment as well as maximum 50-100m from axis line;
- vegetation extermination: full length of establishment as well as maximum 50-150m from axis line;
- earthworks: full length of establishment as well as maximum 20m from axis line;
- water constructional works: change can be calculated in 100m track along the line;
- material transport: pollution can spread maximum 50-100m, right and lift side along the line;
- dam effect: full length of the line;
- establishment maintenance, chemicals, salting: along the line, 5-10m track from pavement edge;
- traffic, material emissions: intensive pollution can spread to maximum 25-30m track, pollution can spread to 50-100m;
- average: 1-200m track from line;

4. *Impact constraint ability is in relation with sensitivity and loading capacity of impact wearers. Based upon these, different road-environment types can be determined in the aspect of impact forwarding. Impact forwarding of impact wearers of road-environment can be characterised by guiding numbers.*

Areas situated along the roadside can be grouped according to those aspects how environmental elements react to each impact factors and how these participate in impact forwarding. I examined impact forwarding ability of each environmental element in detail, and I determined typical ranges. With the help of different outward forms of impact wearers, various road-environmental types can be defined. Different characteristics, facilities characterise impact wearers in each road-environmental types. In case of impact assessments, author founded that air and water are those environmental elements, which have fastest impact forwarding ability spreading to the largest area, while soil and flora react slower to various changes and, as primary impact wearers, their territorial extension is smaller.

Based upon research examinations the following road-environmental types were defined:

For high-sensitive road-environment, fast impact forwarding processes are typical in concerning impact wearers. Its most important characteristics are land surface rich in waters, considerable air movements, lack of roadside edges, low plant coverage, sensitive and low tolerance species of plants and animals. Soil structure is crumbly; it has good water and air housekeeping. Ecosystems of the area belong to water or forest ecosystems consisting of elements being in close connection. Water and air can be considered as definitive impact wearer, but impact area extension is larger than 150m. In case of air, maximum distance of impact-extension guide number can be estimated 1km, but in case of living water flowing across, defining of maximal extension requires further, individual considerations.

In case of **sensitive road-environment,** impact decreasing edges can already be found along the roads. On direct impact area surface water flowing cannot be found, subsoil water flows 0,5-2m under the ground. Plant coverage of the soil is medium. Most of concerning species of living world do not react sensitively to changes, their tolerance can be told as medium. Mostly, forest ecosystems can be found on the area, which are in interaction with each other. . Living world and water flowing underground can be considered as definitive impact wearer, but impact area extension is between 50 and 100m.

In **normal road-environment**, closed, multilevel edges can be found along the roads, which considerably decrease effects. Water appearings are not typical on the whole impact area of the road, subsoil water flows deeply, in layers 2m under the ground. Soils has large plant coverage, its structure is massive, its water and air housekeeping is characterised by slower processes. Euryecious, well complying and accumulating species form dominance in living world of impact area. Open ecosystems are typical, whose elements have no close connection. Soil and living world can be considered as definitive impact wearer, its impact area spreading is less then 50m.

During impact assessment procedures, in preparation phase it can already be defined, which road-environment types is affected by planned establishment, and estimated ranges have already become given with this. If we illustrate road-environmental types of affected area in form of map, definition of area of plantation alternatives become easier, and an opportunity presents itself to hedge poor conflicted corridors in more simply..

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