# ORTHOLOGICAL MANAGEMENT OF HYDROLOGICAL RUNOFF BASINS OF THE PREFECTURE OF DRAMA (CURRENT SITUATION – PROTECTIVE ACTIONS – PERSPECTIVES)

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**Abstract:** This paper presents the torrential environment of the torrents of the area of the prefecture of Drama. Firstly, the torrents of the area and their morphometrical and hydrological characteristics are imprinted. At the same time, the torrential environment (potential) is specified with the analysis of the basic torrential factors (climate, relief, geological base, vegetation). After that takes place the calculation of the maximum expected water discharge and sedimentary flow with the use of empiric and analytical types. The constructive and operational characteristics of the most important hydrological constructions of the area are synoptically described. According to these data, the present situation is defined, the water potential of the area is evaluated and some further solutions are proposed for the best possible utilization of the water environment. These data were gathered and digitized in a geographical database.

**Keywords:** torrential environment, aquatic environment, sustainable management, hydrological basins of the prefecture of Drama

## 1. Introduction

Water is a valuable and renewable natural resource, the misuse of which may lead to deterioration of its quality and reduction of its reserves. From the total amount of water of the planet, a very small part is drinkable (potable) water, which can be consumed by the man in his activities. From this quantity a 83 - 87 % is consumed by agriculture through irrigation and a 10 – 12 % for water supply.

In addition to the fulfillment of the human needs, an evaluation of the possible disasters that can occur by water fluids which derive from mistaken interferences in the torrents' beds is also necessary. From the above we see the importance of proper management of the water and the general aquatic environment, which consists not only in the proper use of water, but in full knowledge of water resources in the region.

The knowledge of the water resources of the area requires the identification of the basic torrential factors (climate, relief, geological base and vegetation) for every



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torrent of the three hydrological runoff basins of the prefecture of Drama and the calculation of maximum expected water and sediment discharge of each torrent. This data is used in order to determine the effectiveness of the existing constructions and also propose possible new ones.

## 2. Area of Research

The prefecture of Drama is located on the eastern edge of Macedonia. It belongs to the region of Eastern Macedonia - Thrace, occupies an area of 3.468 Km2 and a population of 103,975 residents (census 2001). It is bordered by the Nestos River and the western Rhodope Mountains to the east, the mountains of Lekani in the southeast, the swamps of Philippi in the south, the Aggitis River and mountain Menikio in southwest, the Vrondou mountains to the west and the Greek-Bulgarian border in the north. The highest elevation occurs at Mount Falakro (2232 m). It extends from latitude 23o 54' to 25o 04'and longitude of 40o 57' to 41o 34'. The prefecture of Drama is divided administratively into 5 municipalities (used to be 8 municipalities and 1 community).

From hydrological point of view, the prefecture of Drama is divided into three major hydrological runoff basins: Drama (hydr. bas. 1), Kato Nevrokopi (hydr. bas. 2) and Nestos (hydr. bas. 3) (Fig. 1). The capital of Drama is almost in the center of the respective basin at south of Mount Falakro, just 160 km from Thessaloniki. It is built on the ruins of the ancient town of Dyrama or Ydrama from which it is clear that its current name originated (Dyrama - Ydrama - Drama), referring, probably, to the rich aquatic potential of the area, which characterizes the city of Drama even today.The largest basin of Drama (1) consists of agricultural land which is crossed by a large number of irrigation canals. Other major settlements in the region (cities, towns) are Prosotsani, Kalambaki, Doxato etc.

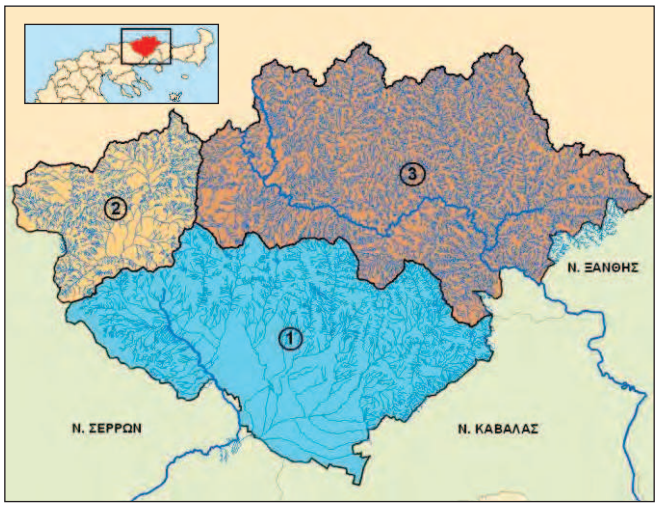


**Figure 1 : Hydrological basins of Drama**

The closed basin of Kato Nevrokopi (2) is surrounded by mountains which limit it (Mount Falakro, Vrondou Mountains, Granitis, etc.). The largest settlement is Kato Nevrokopi and other major settlements are Volakas (located near the ski resort of Mount Falakro), Lefkogeia (with the namesake dam) etc. The whole basin is a plateau (minimum altitude of 540 m) with well developed agriculture.

The hydrological runoff basin of Nestos (3) contains the Greek part of the catchment of the Nestos River. The area is dominated by forests and woodlands. Major settlements are Paranesti, Temenos, Sidironero, Papades, Potamoi etc.

## 3. Methods and Materials

In order to complete this study, were used topographic maps of the GSA (Geographical Service of Army) of a scale 1: 50,000, geological maps of IGME (Institute of Geological and Mining Researches) and the vegetation map of Drama of a scale 1: 200,000 of the Ministry of Agriculture (NSSG – National Statistics Service of Greece). Then, the maps were scanned and stored in electronic form. In this format they were edited with programs like AutoCAD and ArcGIS, leading to the creation of maps and other data.

The maps contain various levels of information, structured in a personal database (Personal Geodatabase), classified as files of the .mxd format, in such a way that will give every time the desired result.

The meteorological and hydrological data used were taken either by the Drama's Office of Land Reclamation or the Laboratory of Mountainous Water Management. The necessary calculations were made in order to determine the maximum expected water and sediment discharge (Qmax) by using the above data, and the morphometric and hydrographic features which derived from the digital processing of maps, and identified the torrential types of river basins.

Finally, the hydrological projects and interventions in the three (3) hydrological runoff basins of Drama were recorded.

Given the torrential environment (potential) of each basin are proposed the necessary projects for their rational management.

## 4. Results

### 4.1 Morphometrical – Hydrographical Features

From the processing of topographical maps and identification of morphological and hydrographical characteristics, came out the following for the three basins of Drama.

In the hydrological basin of Drama (hydr. bas. 1) appear seven (7) torrents with the larger, in terms of area of basin, being the Aggitis. The first three (3) streams emanating from the Mount Falakro have a very high maximum altitude (2.232 m) and maximum torrential altitudes. The average slopes of riverbed and basin vary with the highest values appearing in the torrent Monastiraki (10.12% - 35.64%) and the smaller in torrents Doxato (3.94% average bed slope) and Kyrion (19.76% average basin slope ). The drainage network densities are ranging from 1.51 to 2,75

Km/Km2, while the average altitudes do not exceed 860m (Aggitis 855,3m) with the exception of Monastiraki (1013,4m). It is obvious that this is an area with torrents that have an intense relief but not respectively great average bed and basin slopes.

The Kato Nevrokopi hydrological basin (hydr. bas. 2) contains three (3) torrents with the larger being the Kato Nevrokopi (Mylorema). The maximum altitude reaches 2.100m and the minimum 540m. For this reason, and despite the fact that they are torrents with high torrential and average altitudes, this area does not have very high bed and basin slopes. (Kato Brontous: 36.58% and 6.46%). In addition, the density of the drainage network is greater than those of the previous basin, approaching in two of the three torrents the 3,0 Km/Km2.

Finally, the hydrological basin of Nestos River (hydr. bas. 3) contains 53 torrents with the larger, in terms of area of basin, being the Diavolorema. These are torrents of lowland, semi–mountainous and mountainous areas. The average basin and bed slopes range, respectively, with maximum basin slope in torrential stream Mandra Panteli (57.18%) and the maximum bed slope in torrential stream bed Mavrorema II (27.16%). The drainage network densities for most torrents take values greater than 3,0 Km/Km$^2$ and reaching up to 5,3 Km/Km$^2$.

### 4.2 Determination of Torrential Environment

The torrential environment of the streams of the three hydrological basins is determined by four physical torrential factors (Kotoulas 2001) i.e. climate, topography, geological base and vegetation.

**Climate:** The meteorological data were obtained from 24 stations that operate or have operated in the prefecture of Drama. The nine (9) of them are in the hydrological basin of Drama (1), seven (7) in the hydrological basin of Kato Nevrokopi (2), eight (8) in the hydrological basin of Nestos River (3) and one (1) is in the prefecture of Xanthi, but very close to the limits of the basin 1. The highest average annual rainfall in the basin 1 occurred at station Panorama (1044,7 mm) and the lowest at station Kalambaki (572,63 mm), in basin 2, the highest value was at the station Granitis (978,82 mm) and the lowest at station Lefkogia (696,17 mm), while in basin 3, the highest value appeared at station Volakas (881,51 mm) and the lowest at station Mesochori (670,66 mm).

It is interesting to note, however, that from all the stations of the prefecture of Drama, the 15 have average annual values of rainfall greater than 700mm. This means that the prefecture of Drama receives significant rainfall.

The average annual rainfall in the entire prefecture of Drama, which is 739,05mm, is estimated by using the method of Thiessen. The values for the individual basins are as follows: Drama 713,91mm, Kato Nevrokopi 766,53mm and Nestos 751,26mm.

**Vegetation – Land Uses:** In the hydrological basin of Drama (1), the 36.7% of the area is covered by forests and shrubs. The largest part is covered by deciduous broad-leaved trees (except those listed separately) (14.6%), broadleaf evergreen shrubs (10%), pure and mixed beech forests (5.3%), and pure and mixed oak forests (4.6 %). The hydrological basin of Kato Nevrokopi (2) is occupied by forests and

shrubs at 75.5%. In this area, the largest part is occupied by pure and mixed oak forests (25.2%), pure and mixed beech forests (10%), evergreen broad-leaved (8.1%) and deciduous broadleaf (7.9%). Finally, the hydrological basin of Nestos River (3) is mainly covered by forests and shrubs (95.2%) including pure and mixed oak forests (51.4%), pure and mixed beech forests (15.2%), pure and mixed forests of forest pine (9.6%), evergreen broad-leaved (7.9%). Special mention should be made for the rare in Greek area spruce forest (Picea Abies) which in pure form occupies 0.6% while mixed with forest pine occupies 3.7%.

Regarding land use, in basin 1 there are many agricultural lands (43.45%) and forests (25.95%), while important is the extent of grassland (17.21%). Basin 2 is dominated by forests (64.79%), but there are many agricultural lands (21.8%). Finally, basin 3 is completely dominated by forests (86.94%), as shown in Table 1:

**Table 1 : Land uses per hydrological basins of Drama**

| Land Uses | Drama (1) | | Kato Nevrokopi (2) | | Nestos (3) | |
|---|---|---|---|---|---|---|
| | $Km^2$ | % | $Km^2$ | % | $Km^2$ | % |
| **Forests** | 354,82 | **25,95** | 308,44 | **64,79** | 1422,42 | **86,94** |
| **Shrublands** | 146,76 | 10,73 | 51,15 | 10,75 | 135,77 | 8,30 |
| **Pastures** | 235,37 | **17,21** | 9,37 | 1,97 | 1,69 | 0,10 |
| **Agricultural Land** | 594,21 | **43,45** | 104,04 | **21,86** | 62,15 | 3,80 |
| **Settlements** | 30,64 | 2,24 | 3,03 | 0,64 | 2,32 | 0,14 |
| **Barren** | 5,71 | 0,42 | - | - | 11,80 | 0,72 |

The whole of the prefecture of Drama is dominated by forests (60.1%), followed by agricultural land (21.9%), shrubs (9.6%) and pastures (7.1%). Thus, basin 1 is dominated by agricultural lands (43.45%), forests (25.95%) and pastures (17.21%). In basin 2 a large area is occupied by forests (64.79%), agricultural land (21.86%) and shrubs (10.75%). Finally, in basin 3, there was almost complete dominance of forests (86.94%) and shrubs (8.30%), with small areas of agricultural lands (3.80%).

**Geological Support:** The different types of rocks are grouped into six (6) torrential petrologic formations, according to their vulnerability against the action of precipitation, regardless of the type of group to which they belong (sedimentary, igneous, metamorphic etc.). These formations are (Kotoulas 2001, Stefanidis 1990):

- **Limestone (K) :** $K_A$: sub-formation with phenomena of increased intensity (limestone, dolomite, hornstone) - $K_B$: sub-formation with phenomena of reduced intensity (marble, crystalline limestone)
- **Flysch formation (F)**
- **Schist formation (G)**
- **Neogene (sedimentary) formation (S) :** SA: sub-formation from neogenic, lacustrine and terrestrial deposits with torrential phenomena of increased intensity (sands, clays, marls, conglomerate, breccia, etc.) - SB: sub-formation from neogenic, molasse sediments with torrential effects of reduced intensity.
- **Crystalic-igneous formation (M) :** MA: acid igneous sub-formation with phenomena of mild intensity (granite, granodiorite, monzonite etc.) - MB: alkaline igneous sub-formation with phenomena of normal intensity (ophiolite,

diabase, dokite, peridotite, serpentine, etc.) - $M_C$: transformed sub-formation with phenomena of increased intensity (gneiss, amphibolite, etc.)
- **Alluvial formation (A)**

In terms of the spread of the torrential petrologic formations it turns out that Greece is generally dominated by the sedimentary formation (24%), followed by limestone (19.5%) and schist (18.4%) and followed by the igneous formation (12.6%). The formation of the flysch is quite limited (8.5%). The alluvial formation shows a significant participation (17%) (Kotoulas 2001). In the whole prefecture of Drama, crystalic - igneous formation occupies 28.4%, the limestone 27.7%, the schist 18%, the alluvial 15.6% and the neogene (sedimentary) 10.3%. The following Table 2 lists the torrential petrologic formations per hydrological basin.

**Table 2 : Torrential stone formations per hydrological basin of Drama**

| Petrological Formation | Drama | | Kato Nevrokopi | | Nestos | |
|---|---|---|---|---|---|---|
| | **$Km^2$** | **%** | **$Km^2$** | **%** | **$Km^2$** | **%** |
| Limestone (K) | **619,17** | **45,85** | **126,73** | **26,67** | 214,37 | 13,05 |
| Crystalic - igneous (M) | 7,32 | 0,54 | **169,13** | **35,59** | **810,13** | **49,30** |
| Neogene (S) | 187,68 | 13,90 | 81,36 | 17,12 | 87,88 | 5,35 |
| Alluvial (A) | **474,67** | **35,15** | 61,11 | 12,86 | 5,06 | 0,31 |
| Schist (G) | 61,53 | 4,56 | 36,83 | 7,75 | **525,87** | **32,00** |

Specifically, in the basin of Drama (1) dominates the limestone formation (45.9%), followed by alluvial (35.2%), sedimentary (13.9%) and schist formation (4.6%). In the Kato Nevrokopi Basin (2) prevails the crystalic - igneous formation, which occupies the largest area (35.6%), followed by the limestone (26.7%), the sedimentary (17.1%), the alluvial (12.9%) and schist formation (7.8%). Finally, in the Nestos basin (3) the crystalic – igneous formation (49.3%) predominates, followed by the schist (32%), the limestone (13%) and the sedimentary formation (5.3%). Relatively, for all of Drama we realize that it receives significant rainfall, the prevailing petrologic formations are crystalic – igneous and limestone, and, regarding the land uses, is dominated by a large area of forest and a pretty smaller percentage of agricultural lands. Moreover, a rich hydrographic network flows through the prefecture of Drama, which, in addition to rainfall, is supplied by the many springs of the area. Depending on the percentage that each torrential petrologic formation occupies on the basins of the torrents and the torrential space in which the torrential maximum altitude occurs (0 to 1000m - I, 1000 έως 2000 m - II, etc.) several torrential types are created, each of which presents torrential phenomena depending on the geological formation that prevails. From the torrents of the basin 1, 2 belong to type K.A.S.-II, and one to the types of K-II, K.G.A.-I, A.K.-I, K.S.-I and K.S.A.-I. In the torrents of the basin 2, we see the types of M.K.-II, M.S.K.A.-II and K.M.S.-II for once. Finally, from the torrents of basin 3, 14 belong to the type of G.-I, 5 to M.-I, 5 to M.-II, 5 to G.K.-II, 3 to G.-II, 3 to G.M.-I, 3 to M.G.-II, 3 to G.K.-I, 2 to G.K.S.-I, 2 to K.G.-II, 1 to M.G.-I, 1 to K.G.-I, 1 to K.G.-III, 1 to S.M.-I, 1 to

S.M.-II, 1 to M.K.-II, 1 to M.K.G.-II and 1 to the G.K.M.-II. The first letter of each type means that this torrential petrologic formation covers most of the area of the basin, the next letter the following formation etc.

## 5. Determination of Maximum Expected Water Discharge – Sediment Flow

The maximum water discharge and sediment flow are calculated, by using empirical and analytical formulas, as listed below.

**Table 3 : Maximum expected water discharge and sediment flow ($m^3$/sec)**

| | Torrents | Qmax | Gmax | | Torrents | Qmax | Gmax |
|---|---|---|---|---|---|---|---|
| **1.01** | Aggitis | 552.20 | 139.57 | **3.23** | Nameless (Kitrini Brysi) | 31.16 | 5.34 |
| **1.02** | Mylopotamos | 226.44 | 44.51 | **3.24** | Didymorema | 34.15 | 7.36 |
| **1.03** | Monastiraki (Tsai) | 146.96 | 33.91 | **3.25** | Krinis (Agkathorema) | 29.31 | 6.31 |
| **1.04** | Kalifyto | 230.26 | 51.94 | **3.26** | Nameless (Mesobouni) | 25.32 | 6.82 |
| **1.05** | Makryplagi | 129.28 | 20.99 | **3.27** | Drosorema | 58.49 | 9.75 |
| **1.06** | Doxatou-Agoras | 379.81 | 66.63 | **3.28** | Sterna | 45.79 | 9.34 |
| **1.07** | Kyrion | 144.41 | 29.32 | **3.29** | Kapnofyto | 28.60 | 6.13 |
| **2.01** | Kato Brontous | 185.81 | 39.82 | **3.30** | Aidonokastro | 128.99 | 26.32 |
| **2.02** | Bathytopou | 316.26 | 89.40 | **3.31** | Mesoxoriou | 47.70 | 10.27 |
| **2.03** | Kato Nevrokopiou | 341.77 | 73.24 | **3.32** | Peribleptou | 144.11 | 45.75 |
| **3.01** | Agriokerasia | 23.64 | 4.05 | **3.33** | Polysykou | 49.85 | 13.29 |
| **3.02** | Palia Dimoiria | 21.88 | 4.71 | **3.34** | Nameless Nestou 2 | 36.56 | 9.75 |
| **3.03** | Nameless Nestou | 22.09 | 4.73 | **3.35** | Lykorema | 33.77 | 7.24 |
| **3.04** | Despatis River | 247.74 | 55.58 | **3.36** | Ydromylon | 39.02 | 6.69 |
| **3.05** | Xerias | 51.67 | 11.71 | **3.37** | Mabrorema | 57.89 | 12.40 |
| **3.06** | Mikromilia | 97.36 | 27.59 | **3.38** | Agiou Panteleimona | 125.14 | 21.45 |
| **3.07** | Leimonos (Bathyrema) | 338.52 | 103.44 | **3.39** | Nameless (Er. Aetou) | 42.77 | 8.33 |
| **3.08** | Sidironerou | 58.67 | 12.64 | **3.40** | Nameless Nestou 3 | 31.90 | 7.73 |
| **3.09** | Skalotis | 137.77 | 35.32 | **3.41** | Bathylakkou | 42.53 | 12.89 |
| **3.10** | Petrorematos | 128.87 | 45.00 | **3.42** | Nestoxoriou | 28.44 | 6.96 |
| **3.11** | Mandra Panteli | 31.60 | 6.45 | **3.43** | Asbestolithou | 37.75 | 11.44 |
| **3.12** | Adali Xaradra | 77.85 | 15.89 | **3.44** | Kastanoxomatos | 44.83 | 10.97 |
| **3.13** | Arkoudorema | 287.97 | 87.99 | **3.45** | Koromilias | 49.74 | 15.83 |
| **3.14** | Diabolorema | 369.08 | 99.37 | **3.46** | Mabrorema II | 44.55 | 9.55 |
| **3.15** | Loukatina | 57.96 | 15.60 | **3.47** | Xoirorematos | 62.34 | 15.79 |
| **3.16** | Mylorema | 61.34 | 15.73 | **3.48** | Panioti | 48.26 | 15.35 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **3.17** | Prasinadas | 148.68 | 54.28 | **3.49** | Xasani | 58.68 | 12.58 |
| **3.18** | Dipotama | 272.37 | 112.41 | **3.50** | Mikrokleisouras | 215.76 | 52.81 |
| **3.19** | Agias Barbaras Nestou | 160.17 | 32.69 | **3.51** | Pagoneriou | 33.12 | 7.13 |
| **3.20** | Nameless Nestou 1 | 38.52 | 10.37 | **3.52** | Axladomilias | 81.91 | 27.30 |
| **3.21** | Krya Nera | 73.07 | 19.67 | **3.53** | Bathy Rematos | 21.65 | 5.83 |
| **3.22** | Paranestiou | 21.19 | 3.99 | | | | |

## 6. Conclusion - Suggestions

### 6.1 Conclusions on the Current Situation

In the basin of Drama (1) predominate agricultural lands (43.5%), followed by forests (25.95%). At the same time, in this region there are more settlements and consequently the most people. As a result, basin (1) has the greatest water demands. The lowlands of the basin are crossed by an extensive system of irrigation canals and ditches, while a large number of wells (1,300 within the whole county) increase the available water resources. Moreover, many karstic springs appear, fed by the Mount Falakro, and there are several others in this basin, as well as throughout the prefecture. The ombrothermic climatic (rain-temperature) diagrams indicate a dry-hot period in July, August and September. This phenomenon intensifies in August, creating a reduction of the available water resources, which coincides with the period of the higher demand for water. The average annual rainfall amounts to 713,91mm. The basin of Drama is divided into seven smaller basins, largest of which is that of Aggitis River. In its bed has been constructed a dam, for the concentration of water for irrigation purposes next to Megalokampos village. In terms of geological medium is dominated by the torrential petrologic limestone formation (45.85%), followed by alluvial (35.15%) and sedimentary (13.90%), thereby obtaining the proportional torrent phenomena that characterize each formation.

In the Kato Nevrokopi basin (2) there are several agricultural lands (21.8%) but it is dominated by forests (64.79%). The ombrothermic climatic (rain-temperature) diagram of the area shows a minimum dry-hot period in August. This is mainly due to low temperatures of basin (2) and not the high average annual rainfall (766.53), which is much higher than the basin (1). The basin is divided into three smaller basins, with the larger being the Kato Nevrokopi basin. Characteristic of basin (2) is the existence of two earthen dams in Katafyto and Lefkogeia, in order to obtain water for irrigation and water supply. All five torrential petrologic formations are displayed with significant percentages. The dominating formations are the crystalic - igneous (35.59%) and the limestone (26.67%).

The Nestos River basin (3) is almost completely dominated by forests (86.94%), suggesting, in combination with the Nestos River that crosses it, an invaluable natural environment with significant forests, such as forest Frakto (where the virgin forest lies) and the forest of Elatia (Karantere), and rich aquatic resources. The average annual rainfall of the basin is 751,26mm. The basin (3) contains 53 torrents, the larger of which is the torrent Diavolorema. Also, on the Nestos River had been constructed two hydroelectric dams (Thysauros, Platanovrisi) which produce large

amounts of environment-friendly electric energy. The area is dominated by the crystalic - igneous formation (49.30%), the schist (32.00%) and limestone (13.05%).

### 6.2 Conclusions – Suggestions for Rational Management

According to the above, the prefecture of Drama is quite rich in terms of water resources. He has an extensive irrigation network in the plain of Drama, the creation of hydroelectric dams of the Nestos River offers a lot in generation of environmentally friendly electricity (Xanthouleas 1994, Tsiknakos 1993) and the creation of dams for water concentration helps for the better management of this wealth. Many things, however, can be done in this direction. The cave at the spring of Aggitis River, which is a unique monument of nature, and the ski resort of Mount Falakro, with plentiful snow and many tracks, may be further developed and continue their advertising which has intensified in the last years.

Most important of all, however, are the needs for water supply and irrigation. The intensification of agriculture and the concentration of population in urban centers create ever increasing demands on water resources. It has already been noted (Pantartzis 1993) the difference between required and offered water for irrigation and had been a proposal to build a tunnel carrying water from the dam of Platanovrisi to the plain of Drama. But this remained a proposal (Kissoudis 2003), intensifying the shortage of water for irrigation.

On the other hand, the dam of Temenos, which would regulate the output of the hydroelectric station Platanovrisi and feed the irrigation networks daily, is not built yet and as a result there can't be constant flow of water for irrigation. The construction did not take place because, according to Public Power Corporation's conditions of economic attractiveness of the project are not fulfilled.

From the above it is understandable that there are important issues to be solved in the aqueous environment of the prefecture of Drama (Delidis et al 1993). The demands of agriculture are very significant, of course, but any action should respect the environmental balance and avoid causing irreparable damage. The irrigation and water supply from the water of the drainage network (rivers, streams, etc.) and the drillings of the area should be up to a limit, especially during the summer period, in order to supply the necessary water for the proper functioning of the aquatic ecosystem (Diamantis, Mpellos 1993). The continued over-exploitation of groundwater will almost certainly lead to problematic situations. Particularly for wells, should be achieved not only the rational use of water, but their more accurate spatial distribution, in order to manage the sustainable use of the existing water resources. The proposal to transfer water from the dam Platanovrisi for irrigation in the plain of Drama and ponds Philippi (Kissoudis 2003), gives a solution to water deficit, but does not solve the problem nor ensures the situation to further growth in water requirements. The principle of sustainability must be ensured, without sacrificing or altering the water reserves.

Agriculture is the largest consumer of water and so reduction in losses in this sector will lead to big water savings. A first move that should be done is to abandon methods of irrigation such as spraying and flooding, especially in the afternoon hours when showing the biggest losses from evaporation. Instead of that, can be used drip irrigation. There should also be proper and regular maintenance of the irrigation

network to avoid unnecessary water losses from potential disasters or failures during manufacturing.

The choice of suitable crops that will be consistent with the existing water conditions, is also important, i.e. to avoid those that require large amounts of water. There is a clear tendency of researchers towards finding plants (varieties) with the same production as the existing, but with lower water requirements. It is therefore essential to use rationally the hydrological runoff basins in order to make the best possible use of water resources (Kissoudis 1993). The excess amount of water during the winter - more precipitation – flows through the torrents to the larger recipients and ultimately to the sea. This water is possible to be contained with the construction of dams and reservoirs that would help reduce the water deficit in the region (Stefanidis 1993, Pantartzis 1993). At the same time, horticultural and technical constructions are proposed in mountainous basins with disturbed natural environment, in order to minimize the loss of soil, enrich groundwater aquifers and to achieve the counterbalance slope in beds of torrents.

In recent years, however, has begun a program of afforestation of agricultural areas in the basin of Drama through subsidies to farmers. The area that has been afforested in this way is still very small (0.285%) but an indication of what might happen if there is will or motivation. The species selected for this process is poplar, walnut, pseudoacacia, pine (Konstantinidou, Mentis 2003). However, it is noteworthy that in this program also joined farmers whose fields are located in areas with soils of high production. The exploitation of water though, is not limited to direct consumption. Another use is to produce energy with the construction of hydroelectric dams, combining meeting energy needs with gathering water for irrigation or water supply (Kissoudis 2003). This energy recovery became a reality in the dams of the Nestos River (Thysauros, Platanovrisi,) but must be completed with the construction of the dam at Temenos.

One other operation that can bring economic benefits to local residents without altering the quality or quantity of water resources is the tourist exploitation of the rich aquatic environment of the prefecture of Drama. The presence of the ski resort on Mount Falakro exploits the rich snow falls there, but it can be advertised better, as it started lately. The same should apply to other areas of natural beauty such as the cave of the spring of Aggitis, the springs of Agia Barbara, etc. or man-made structures such as dams at Thysauros and Platanovrisi on Nestos River, the dam of Lefkogia in the basin of Kato Nevrokopi etc.

All these figures reported in this work were organized into a geographical database. It is necessary for something similar to be used by the government, with more detailed information for each stream and continuous information from which we derive the necessary information needed to solve the problems that we face. This has been done for the forest area of the Frakto, showing particular interest because of the presence of the Partheno Forest (Meliadis, Mentis 1997).

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