

Impact of Groundwater Fluctuations on Cropping Pattern in Khatav Tahsil: A Geographical Analysis

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Abstract

Groundwater is a significant natural resource, and is vital for the sustenance and development of agriculture. It is essential not only for sustenance of human life but also for the economic and social process of area. In India, about 67 percent population is engaged in the agriculture, there, groundwater is the major water source of agriculture. Khatav tahsil is a drought prone area of Satara district having big problems of water scarcity. Since, the minimum rainfall, well and tube well are the major source of water for agriculture as well as for drinking purpose in the tahsil. In fact, minimum groundwater level is reached in entire eastern and south-eastern part including almost entire Mayani and some parts of Vaduj and Khatav circle. In Mayani circle, groundwater level depth is measured about 11 mbgl in pre-monsoon as well as post-monsoon. Present paper is an attempt to study the effect of groundwater fluctuation on cropping pattern in Khatav tahsil. The crops data have been collected from the village records. The groundwater data have been showed in the form of tables and thematic maps of GIS. The analysis reveals that, there are significant changes in cropping pattern. Traditional crops like, Jawar, Groundnuts, Cotton, Onion, Potato etc. crops have principally sown in the tahsil.

Keywords: Drought Prone, Fluctuation, GIS, Groundwater Level, Traditional Crops.

1.0 Introduction

Ground water is one of the vital natural resources of country, which are key part of agricultural development to boost up agricultural productivity. It is declined almost everywhere on the Earth's surface. About 50 percent fresh water is stored as groundwater on the earth. Ground water has a crucial role in sustaining stream flow between precipitation events and especially during drought periods. In addition to human uses, many ecosystems are dependent on groundwater discharge to streams, lakes, and wetlands.

Although humans have been digging wells and tunnels for water supply for thousands of years, extensive use of ground water is relatively recent, with the advent of rural electrification and more effective drilling and pumping technologies during the past 75 years. Now a day, groundwater is becoming a major source of drinking water if it is essential for the vitality of agriculture and industry.

1.1 Groundwater

Water that collects or flows beneath the earth's surface, filling the leaky spaces in sediment, and

rocks are called as groundwater. It originates as rainfall moves through the soil into the groundwater system, where it ultimately makes its way back to surface streams, lakes, or oceans. "All the waters contained in the pores and fissures of rocks beneath the earth's surface are classified as 'Ground Water' "Water existing in voids and fissures of rocks is called groundwater"

1.1.1 Groundwater Fluctuation

Groundwater fluctuation is the general seasonal movement of groundwater level beneath the earth surface. Generally, the pre-monsoon period, indicates high depth of groundwater and post-monsoon period shows low depth of groundwater.

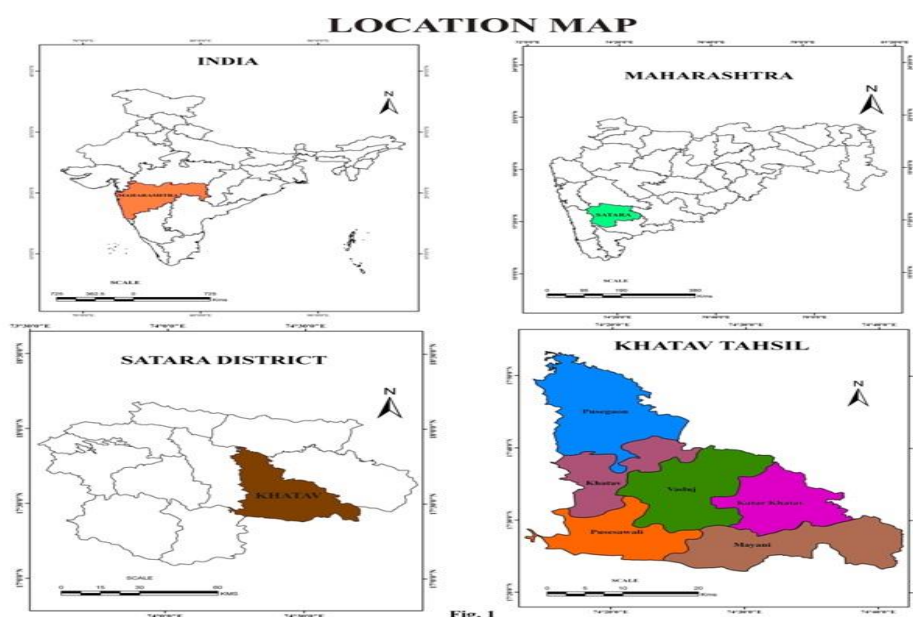
"The Up and Down movement (in interior of land) of groundwater level in different season are known as groundwater fluctuation" "Beneath the earth surface, with seasons, increase- decrease depth motion of groundwater level is referred as groundwater fluctuation"

1.2 Objectives

The specific objective of the present paper is to study the effects of groundwater fluctuations on cropping pattern in the study area and to suggest viable suggestions to increase the crop production in the study region.

1.3 Study Area

The study area has occupied the south-western part of Maharashtra and is located between 17022'48" (17.38) to 17053'24" (17.89) north latitude and 74013'12" (74.22) to 74042'00" (74.7) east longitude. Total area is 1377.79 sq. km., comprising about 143 no. of villages. According to Census 2011, total population of tahsil is about 2, 75,274 persons. From west to east rainfall decreases, yearly average rainfall of Vaduj is 512.2 mm. The major crops are as Bajara, Kharif Jowar, Rabbi Jowar, potato, fruit farming and pulses. Agricultural is the main land use in the tahsil with more than 75% of the total area is being used for agricultural activities.



1.4 Data Base and Methodology

Present work is based on field observations and secondary data collected from various sources. The groundwater level data is reliable and accurate which has been used for this study.

The required secondary data was collected from following sources-

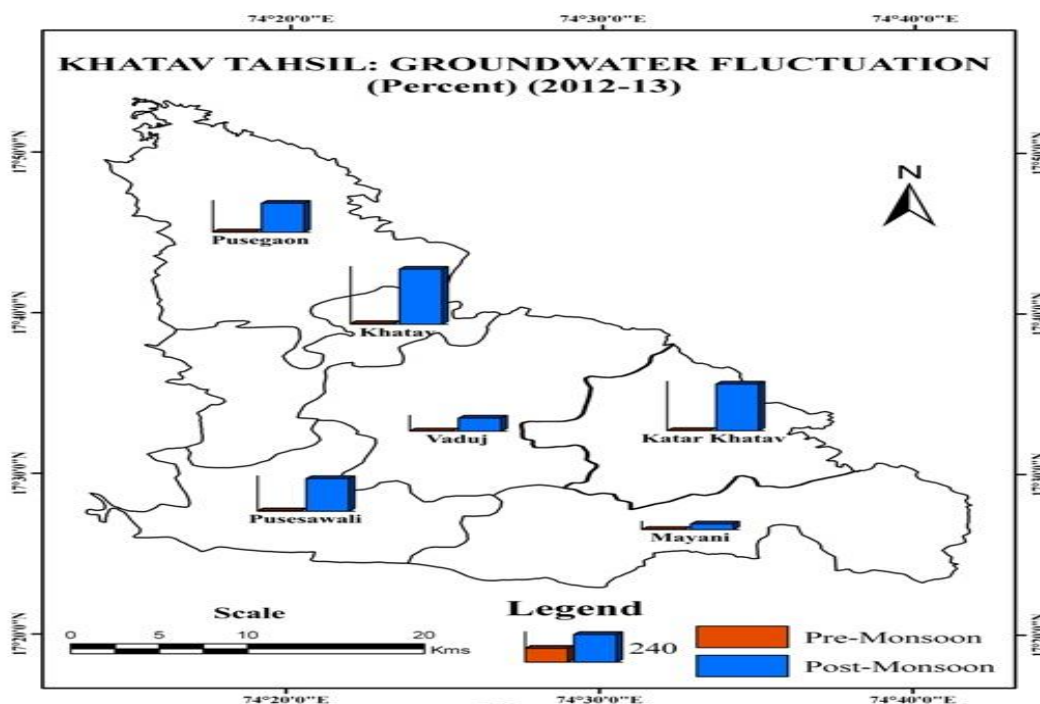
- 1) Groundwater Survey Department Agency, Satara

tabulated and analyzed by using various statistical techniques, wherever, necessary data is presented with the help of suitable thematic maps prepared with GIS techniques. The processed data has been presented in the form of maps and tables. Fluctuation of groundwater is calculated by equation following:

- 2) The District Gazetteer of Satara.
- 3) Socio-Economic Abstracts of Satara Districts.
- 4) Agricultural Office Report, Khatav Tahsil

In the present study, tahsil has been considered as a basic unit of investigation. The collected data has been

$$\text{Fluctuation of Groundwater in Percent} = \frac{\text{Post Monsoon groundwater level} - \text{Pre-Monsoon groundwater level}}{\text{Pre-Monsoon groundwater level}} * 100$$



1.5 Groundwater Fluctuation In Khatav Tahsil

Khatav tahsil comes in drought prone climatic condition area. Where, the rainfall distributes unequally from area to area, ranges between 200 mm. and 550 mm. There is observed 6.03 mbgl and 5.27 mbgl groundwater level in pre-monsoon and post-monsoon respectively. Also, there is

counted 2.55 percent and 250.08 percent groundwater fluctuation in pre-monsoon and post-monsoon respectively. In case of total tahsil, average 126.32 percent fluctuation of groundwater.

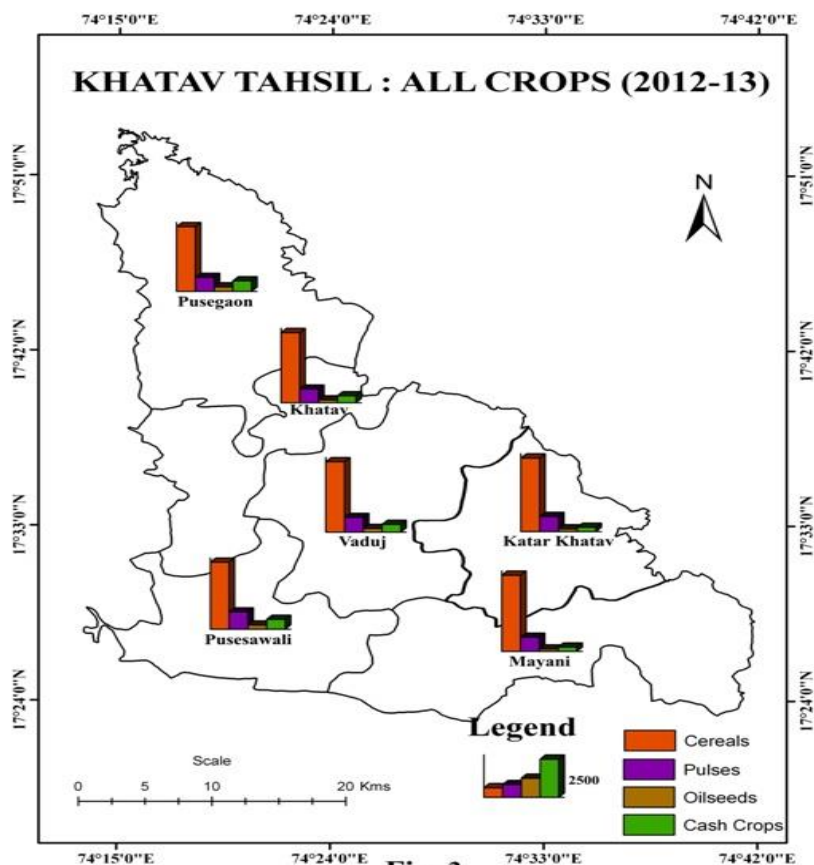


Fig. 3

Table I
KHATAV TAHSIL: GROUNDWATER FLUCTUATION
(2012-13)

Sr. No.	Name of Circles	Pre-Monsoon		Post-Monsoon		Average	
		Level (mbgl)	Fluct.(%)	Level (mbgl)	Fluct. (%)	Level (mbgl)	Fluct. (%)
1	Pusegaon	5.60	2.77	4.60	256.86	5.10	129.82
2	Khatav	6.00	5.42	6.50	486.51	6.25	245.97
3	Pusesawali	5.50	3.24	2.30	287.91	3.90	145.58
4	Vaduj	4.80	1.58	6.50	115.81	5.65	58.70
5	K. Khatav	3.10	0.79	0.60	412.00	1.85	206.40
6	Mayani	11.15	1.95	7.55	50.00	9.35	25.98
Average of tahsil		6.03	2.55	5.27	250.08	5.65	126.32

m bgl = metre below groundwater level
Satara.

Source: Groundwater Survey Department,

Table I and fig. 2 shows the fluctuation of Khatav tahsil in 2012-13. Pre-monsoon Period has seen the fluctuation of groundwater during the month of March and May. Post-monsoon Period has shown the fluctuation during the month of October and January.

In pre-monsoon period, Katar Khatav circle has noted maximum groundwater level, showing 3.1 m bgl depth of groundwater level. The Khatav circle has indicated dominant fluctuation of groundwater. There is about 5.42 percent fluctuation of groundwater. The Katar Khatav circle has indicated minimum fluctuation of groundwater. There is about 0.79 percent fluctuation of groundwater. In case of total tahsil, there is reached averagely 6.03 m bgl depth of

groundwater level and 2.55 percent fluctuation of groundwater. Besides, Pusegaon, Pusesawali, Vaduj, and Mayani circle are shown medium groundwater fluctuation.

In post-monsoon period, Katar Khatav circle is again noted maximum groundwater level, showing just 0.6 m bgl depth of groundwater level. Like these, the Khatav circle is again indicated dominant fluctuation of groundwater. There is about 486.51 percent fluctuation of groundwater. The Mayani circle is exposed the minimum (about 50.00 percent) fluctuation of groundwater. In case of total tahsil, there is reached about 250.08 percent fluctuation of groundwater. Besides, Pusegaon, Pusesawali, Vaduj, and Katar Khatav circle are shown medium groundwater fluctuation.

1.6 Cropping Pattern In Khatav Tahsil

In the simple word cropping pattern means the production of area under various crops at a point of time. In any region, it always shows variations or change. This change occurs due to variations in amount of rainfall, availability of irrigation, agricultural inputs like capital, fertilizers, pesticides etc., variety of seeds, technical knowledge etc.

Crop pattern is the proportion of area under different crops at a particular period of time. Nearly 126.32 percent average groundwater fluctuation is exhibited in tahsil. Hence, there is found to be mostly cereal as well as pulse crop. A sugarcane and cotton crop has just 10 percent area in the tahsil. Also, there is the effect of climate for change and distribution of crop.

Table II
KHATAV TAHSIL: ALL CROPS (2012-13)
(In Hectors)

Sr. No.	Crops	Pusegao n	Khatav	Pusesawali	Vaduj	Katar Khatav	Mayan i	Total
1	Cereals	4187	4539	4328	4559	4761	4933	27307
	%	69.13	75.19	68.37	72.94	77.08	78.58	73.55
2	Pulses	898	878	1106	948	972	912	5714
	%	14.83	14.54	17.47	15.17	15.74	14.53	15.39
3	Oilseeds	292	177	264	239	172	154	1298
	%	4.82	2.93	4.17	3.82	2.78	2.45	3.5
4	Cash Crops	680	443	632	504	272	279	2810
	%	11.23	7.34	9.98	8.06	4.4	4.44	7.57
Total		6057	6037	6330	6250	6177	6278	37129
%		16.31	16.26	17.05	16.83	16.64	16.91	100

Source: Report of Agricultural Department, Vaduj

Table II and fig. 3 is shows the circle wise sown crops area of Khatav tahsil in 2012-13. Cereals crops are the predominant crop, sown in the 27307 hect. area. In case of tahsil, there is dominantly occupied about 73.55 percent cereal crops area, hence this tahsil renamed as the “Cereal Tahsil” of Satara district. Pulses crops are the second dominant crop, is sown on 5714 hect. (15.38 percent) area. Cash crops are the very lowest area, covers just 2810 hect. (7.57 percent) area. And last Oilseeds crops are important but very lowest occupied area, which is sown on 1298 hect. (3.50 percent) area. Cereal crops include paddy, Jawar, Bajara, Ragi, Wheat, Maize etc. crops. Pulses crops involves Tur, Mung, Grams, Udid etc. crops. Oilseed crops include Groundnut, Sesamum, Niger, Sunflower, Soyabean etc. crops. Cotton as well as Sugarcane crop involves in Cash crops.

1.7 Impact of Groundwater Fluctuation on Cropping Pattern

Cropping pattern and groundwater fluctuation have the change behavior over space and time. But, cropping pattern is the proportion of area under various crops and groundwater fluctuation is the general movement of groundwater level (rise and fall) in beneath the earth surface. Therefore, groundwater fluctuation is controlled the cropping pattern. In reality, maximum groundwater fluctuation has become the maximum area under cereal crop and minimum fluctuation has confined the minimum area under cash crop.

Table III
KHATAV TAHSIL: GROUNDWATER FLUCTUATION
And ALL CROPS (2012-13) (In Hectors)

Sr. No.	Crops	Pusegaon	Khatav	Pusesawali	Vaduj	Katar Khatav	Mayani	Total
1	Cereals	4187	4539	4328	4559	4761	4933	27307
	%	69.13	75.19	68.37	72.94	77.08	78.58	73.55
2	Pulses	898	878	1106	948	972	912	5714
	%	14.83	14.54	17.47	15.17	15.74	14.53	15.39
3	Oilseeds	292	177	264	239	172	154	1298
	%	4.82	2.93	4.17	3.82	2.78	2.45	3.5
4	Cash Crops	680	443	632	504	272	279	2810
	%	11.23	7.34	9.98	8.06	4.4	4.44	7.57
5	Total	6057	6037	6330	6250	6177	6278	37129
	%	16.31	16.26	17.05	16.83	16.64	16.91	100

6	Fluctuation	1	-0.5	3.2	-1.7	2.5	3.6	0.76
7	Fluctuation (%)	17.85	-8.33	58.18	-35.41	80.64	32.28	12.6

Source: Calculated by Researcher

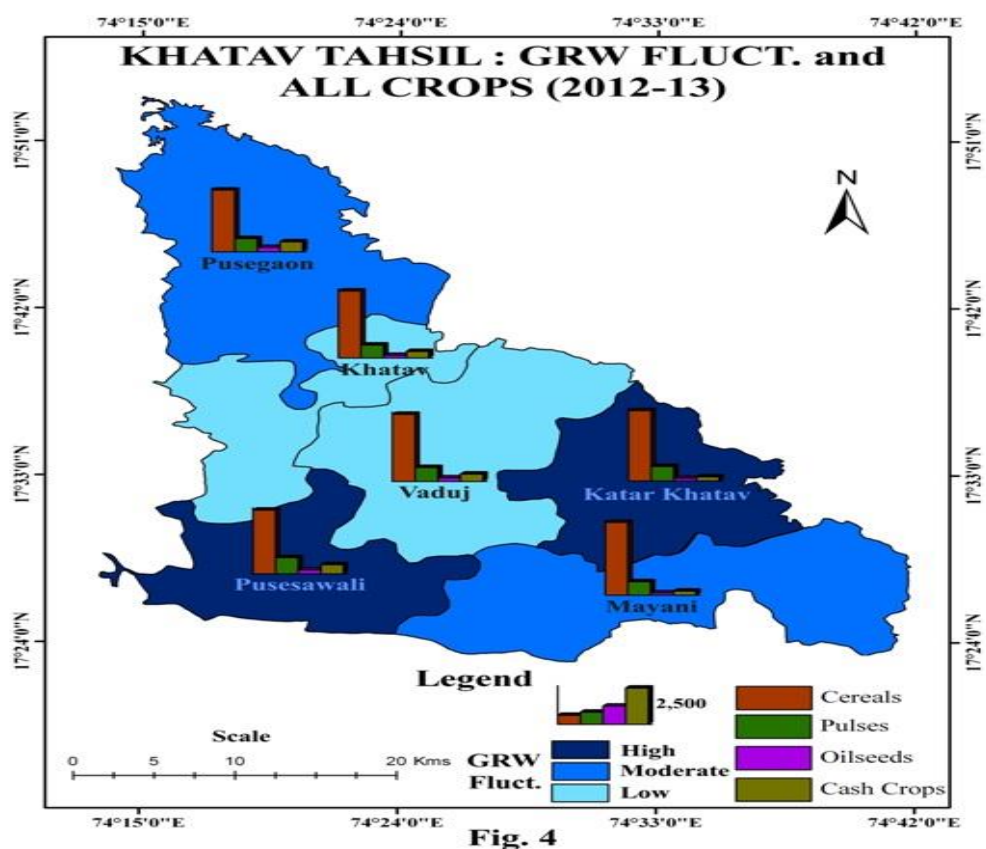


Table III and fig. 4 shows the cropping pattern and fluctuation of groundwater in Khatav tahsil in 2012-13

High Fluctuation:

These are comprised above 40 percent fluctuation of groundwater. The high fluctuation of groundwater is found in Khatar Khata and Pusesawali circle, are seen 80.64 percent and 58.18 percent fluctuation of groundwater respectively. There is reached the maximum area under Cereal crops and minimum area under Cash crops and Oilseed crops.

Moderate Fluctuation:

These are involved between 10 percent and 40 percent fluctuation of groundwater. The moderate fluctuation of ground water is shown in mayani and pusegaon circle, is seen 32.28 per cent and 17.85 per cent fluctuation of ground water. There is observed maximum area under cereal crops and minimum area under oilseeds.

Low Fluctuation:

These are belonged below 10 percent fluctuation of groundwater. The low fluctuation of groundwater is seen in Khata and Vaduj circle, is seen 32.28 percent and 17.85 percent fluctuation of groundwater respectively. There is found the maximum area under Cereal and Pulse crops, also there is better cultivation of Cash crop. The minimum area is observed under Oilseed crops.

Other impacts of fluctuation of Groundwater on cropping pattern in Khata tahsil are:

1. There's rainfall falls uncertainly and unequally distribution. Therefore, crops distribution contains unequally.

2. High water requires crops cultivates only in Yerala river basin. e. g. sugarcane and fodder crops.

3. If rainfall comes late in rainy season, Kharif season is failed, which do not have any crop cultivation.

4. Also, rainy season contains most water requires crops e.g. maize, soyabean, groundnuts, vegetables.

5. There are sown only minimum water necessity crops.

6. Cereal crops are the predominant crop in tahsil.

7. Jawar crop is the focal crop of tahsil (about 63.83 percent), because, this crop comes only on rainfall water.

8. Pulse crops is majority crops having 5714 hect.(15.38 percent) area in tahsil.

9. In summer season, majority crops cultivates in Yerala Basin.

10. Cotton crop takes or cultivates in summer season.

11. Oilseeds crops and cash crops are sown on the below 10 percent area in tahsil.

12. Tur, groundnut, niger etc. crops are sown on less than 1 percent area in tahsil.

13. High level of crop diversification in Jawar, Grams, Bajara, Maize, Wheat, Soyabean, Cotton, Udid etc. crops is counted in tahsil.

14. There are noted monoculture combinations (Jawar crop) to eight crop combinations.

1.8 Conclusion and Recommendations

In khata tahsil, rainfall has decreasing from west to east. Normally, this tahsil is observed the rainfall between 450 mm. and 550 mm. and temperature maximum 36⁰c and minimum 14⁰c. These factors controlled the

groundwater. So, there have been sown less water needs crops.

Hill ranges (height-above 900 m) covers dominant area (41.52 percent) in tahsil. Therefore, most area especially western and north-western part is counted high groundwater fluctuation. Therefore, there has been cultivated mostly cereal crops.

Yerala river and her tributaries are flowing in the deep and low areas. But there is, rainy and winter season have better situation of water or groundwater. Hence, short period cash crops cultivated in the Yerala basin- Maize, Onion, and potato.

Katar Khatav circle has the highest fluctuation (about 80.64 percent) of groundwater, there is largely taken cereal crops especially Jawar crop production. Similarly, Pusesawali circle involved mostly cereal crop production.

Whereas, Khatav and vaduj circle is counted very less groundwater fluctuation, includes -8.33 percent and -35.41 percent groundwater fluctuation, there is cultivated and taken Cash and Oilseed crops. These both circle is seen most watershed development programme work e.g Percolation Tank, Village Tank, Kolhapur Type Bunds, Underground Bunds, Lift Irrigation etc.

Some Important recommendations:-

The following recommendations are given for the overall increase crop production and minimize groundwater fluctuation of study region:

- Farmer should carefully use the groundwater and should follow mechanical measures for conserving

water such as contour bunding, contour trenching etc.

- Every farmer should use different water saving irrigation methods (drip and sprinkler irrigation)
- Government, Semi-Government and Educational institutions participate in the Programs of Water Awareness and Water Literacy.
- Govt. should increase awareness about significance and effects of water conservation to people through the T.V. and Radio Programmes.

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