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Sustainability in agricultural systems: A geographical study of Narmada Basin of Madhya Pradesh

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Abstract
The paper presents an overview of low inputs methods using to enhance sustainability in agriculture of Narmada Basin of Madhya Pradesh. It comprised of 21 districts[2] of the state as Anuppur, Alirajpur, Badwani, Balaghat, Badwani, Betul, Chhindwara, Dhar, Dindori, Harda, Hoshangabad, Khandawa, Khargone, Mandla, Seoni, Indore, Katni, Raisen, Jabalpur and Dewas. This region of Madhya Pradesh is known as Narmada Basin. It is one of the 10 Rivers basin of Madhya Pradesh. Agriculture is the main occupation of this area. Total Net Sow area is recorded 43 % of the total geographical area.
The aim of the paper is to examine the Low input Methods in agriculture context of sustainability of Natural resource of the region. The paper is based on conventional primary and secondary sources of data with relevant methodology. Primary data has been collected through scheduled Questionnaires in the year 2020.

Keywords: low input methods, organic manure, watershed management, natural resource

Introduction
At present scenario agriculture has transformed in tune with the growing population and its challenging needs. This chapter comprises the study on the model of sustainability. According to the model this paper analyzed low input method to conserve natural resources like Soils water etc.
Madhya Pradesh is well known state In term of organic farming. In Madhya Pradesh organic farming is started from year 2001. In this way organic farming is started in 313 villages, subsequently it was started in two villages in each blocks, so the number of village increased to 1565 in 2003 than it is also increased to 3130 when 5 villages were selected in each block in 2006. In this way the program of organic farming is going on in 3130 villages at present (FWADDMP) [1]. The model of Sustainability by JNKKV [2] has been considered as the basis for conducting the study of sustainability in the study area.

Sustainability
Is the longtime stability of resources, environment and economy in a simple word we can say Sustainability is a balancing act.
Definition of Sustainability "to include the idea of a global society founded on respect for nature universal human rights economic justice and a culture of peace" (earth charter 2000)

The aim of the study
1. The study aims to discuss about agricultural Systems in Narmada Basin of Madhya Pradesh.
2. To analysis the low- input methods in agriculture and sustainability.
3. To analysis the impact of low input methods on natural resources.

Study Area
Physical characteristics of any area are form the basis of human organization and agriculture thus become a part of the physical characteristics. Nature provides man with a variety of possibilities of human activities including agriculture. Agriculture directly depends on natural environment. The Narmada Basin of Madhya Pradesh has extends between $21^0$20' north to $23^0$45' N and latitude $72^0$32' E to $74^0$21 'E. It is studied that 43% area is occurred under Net Sown Area in the basin. Total forested area is 19481 Sq.km. which accounts 25% of the total area. Area which is not available for cultivation is approximate 2% and other land is found under 28%. Four types of agricultural systems in Narmada Basin of Madhya Pradesh have been identified:
1. Intensive subsistence tillage (with paddy dominance)
2. Intensive subsistence tillage (without paddy dominance)\
3. Commercial Crops
4. Shifting Agriculture

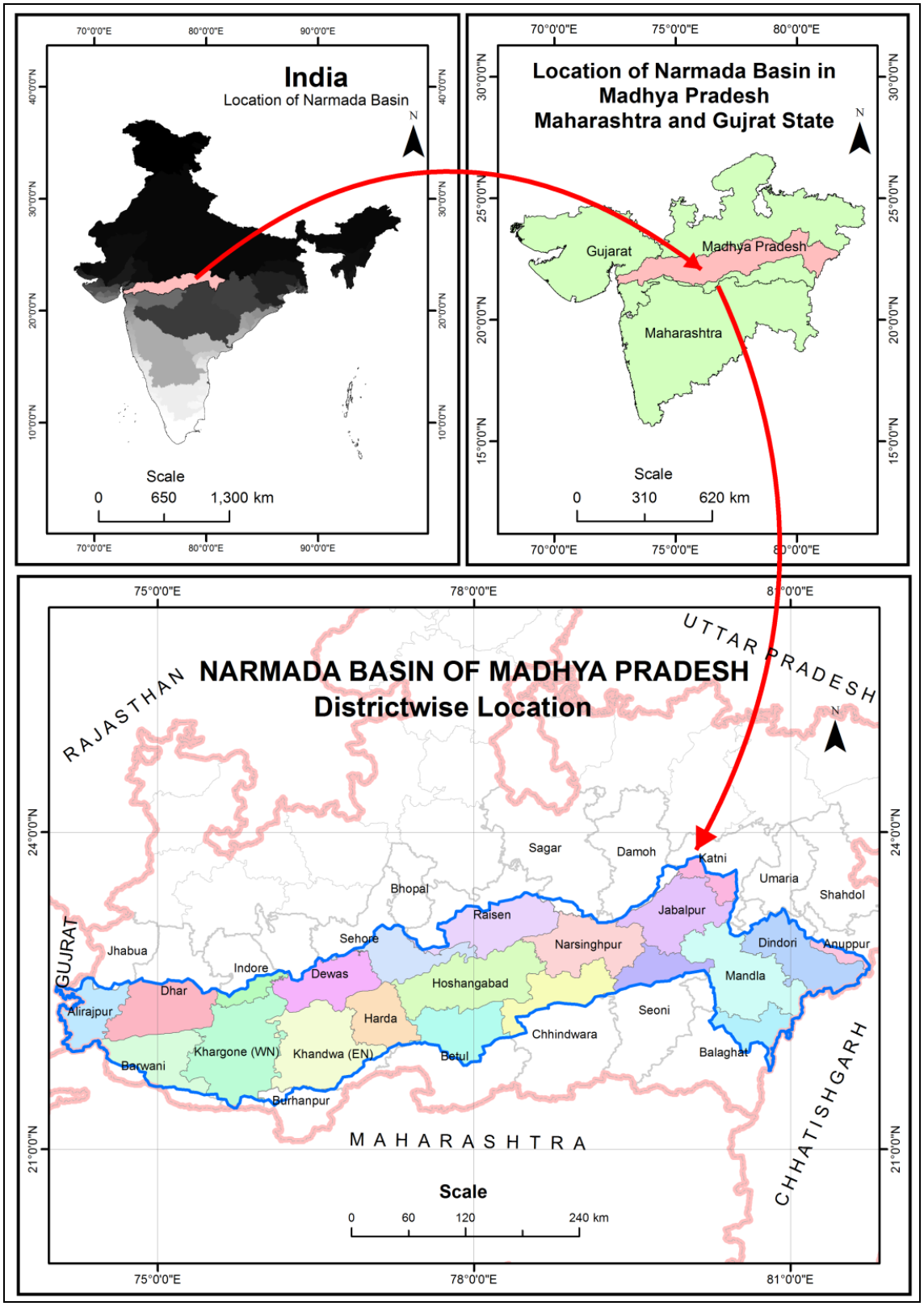


Fig 1: Location Map of Study Area

Concept of Sustainable Agriculture

The goal of sustainable agriculture is to develop farming systems that are productive and profitable, conserve the natural resource, protect the environment, and enhance health and safety and be useful for long term.

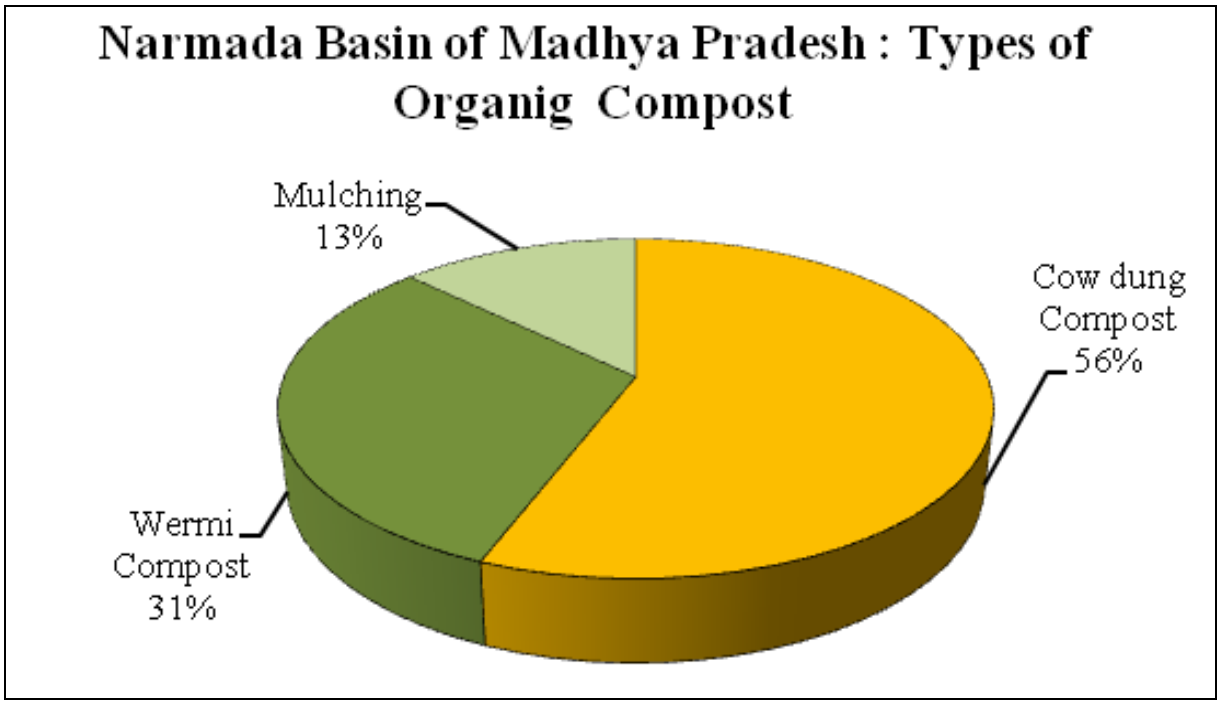
This approach required appropriate law and management practices like crop rotations, use of animal manures, use of conservation tillage to control soil erosion and nutrient losses, maintain and enhance soil productivity, reduce quantity of fertilizers and pesticides, save rainy water and do conservation etc. An attempt has been made to show this concept through the model. Farmers in Sehore districts are growing organic wheat (Sharbati variety). The area under organic cotton cultivation in Khargone and Khandwa districts of Nimar region has also expanded over the years. The farmers of Dewas, Betul, Anuppur Mandala, Hoshangabad and Indore are also

doing this type of farming. This model is based on Sustainable Agriculture Model of united State of America. (JNKVV)
Attention may be paid to the first step of sustainability model that is Low input methods in agriculture which are related to the conservation of natural resources and have better production.

Low Input Methods and Sustainability
It is observed that low Input methods have a great importance to have sustainability of agriculture, this may be discussed as follows -

Integrated nutrient Management and Soil conservation
Integrated nutrient management system is grounded on the use of organic manures, crop residues, bio fertilizers, legumes in crop rotation and green manuring. With the help of these important methods farmers can get good production with low inputs.

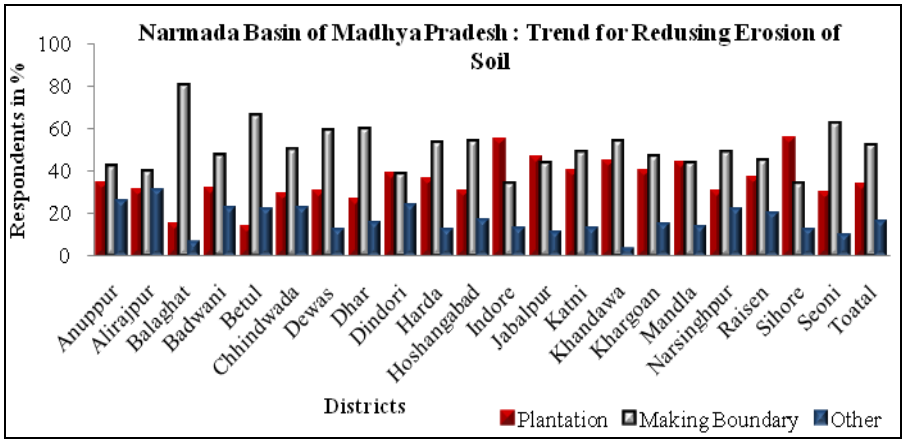
- **Organic Manure:** organic manure or compost play an important role to improve the nutrient of soil for better production, in place of using chemical synthetic and fertilizer. There is high amount of animal husbandry in study area through which good type of organic farming can be done. Organic manure is prepared from cow dung and dead plant's fragments. The use of organic manure in study area is shown through table no. 1 (Appendix) three methods have been observed in the context of making organic manure in study area, which are Cow dung compost, vermi compost and mulching.



Graph 1

It may be observed by the graph no 1 that compost prepared by cow dung is more preferred in the basin. The study region using manure prepared from cow dung is higher than other, which is 55.92% while trend of using Warmi compost is 31.16% and the percentage farmers who are having mulching is 12.9% of the total.
It may be also considered that, more than 70 % of the farmers of upper Narmada Basin of Mandla, Dindori and Harda district are using cow dung compost. In middle Narmada Basin Devas and Alirajpur has been concidered. In term of using vermi compost maximum percentage has been recorded in Betul district 47.47 while minimum percentage found in Khargone district it is 21.12%. Jabalpur, Indore, Narsingpur and Balaghat district are using mulching method.
Nadep, Green Manure, Pit compost, Fowl compost, vermin compost. Biogas slurry, and Nadep phosphor-compost is main organic manure.

- **Recycling of organic wastes:** Crop residues are also used to increase nutritional capacity of soil. Crop residues in combination with organics have been used to improve availability of plant nutrients, soil organic matter, Infiltration rate, microbial population etc. on the basis of available literature Jabalpur, Chindwara, Seoni, and Balaghat in upper Narmada Basin and Khandawa and Khargone in Middle part has been found.
- **Prevent Soil Erosion:** Necessary measures are made in the study area to prevent soil culture, including plantation, bounding and some other methods.



Graph 2

It may be observed through the graph 2 that plantation is the most considered method to decrease the soil erosion. On the basis of table (Appendix.1) Indore district has maximum farmers 54.44%. Sehore and Jabalpur has above 45% of who are involved in plantation method. The minimum percent has been recorded in Betul district it is only 13.11%. For prevent of soil erosion in the study area bounding method has been also found. This method is highly found in Balaghat district with 80.23% farmers. as well as more then 55% of the farmers of Chindwara, Dhar, Dewas, and Seoni district have confirmed the use of this method.
Overall farmers of basin are using bounding method to reduce soil erosion according to 51.94 respondents of the basin.

Integrated Pest Management
Some special measures are taken to protect the crops from pest. It is a sustainable approach to protect crops with the help of biopesticides which is prepared with material of animals dung, bacteria and certain minerals. The advantage of it, is less harmful than conventional or chemical pesticides. This type of use has been observed in some places of district, which are Shahpura in Jabalpur kotma and some places of Anuppur, sehore, Khandawa and Khargone. Bioherbicide is used as biologiacal weed control. It is made by phytotoxins, pathogens and other microbes. In the study area Collego, Biopolaris Triops and Woad warrior bioherbicides are used.

Water conservation
The natural resource management is very essential part of sustainable agriculture, because these sources are counted as the basic factors affected agriculture or affected by agriculture. Human activities affect both of them so it is important to check the quality of resources if not, many of our practices will be in serious risk.

- **River Development Project and Sustainability of Agriculture:** Rever development projects also influenced sustainability of agriculture. Year form RDP seriously aimed to provide water for irrigation, power and management of crops. Basin is rich in rainfall availability in eastern part of the basin but western part is comprised as dry prone land. So the irrigation is required for agriculture. It may be there are so many hydrological projects are started by the government.

Table 1: Narmada Basin of Madhya Pradesh: River Development Projects

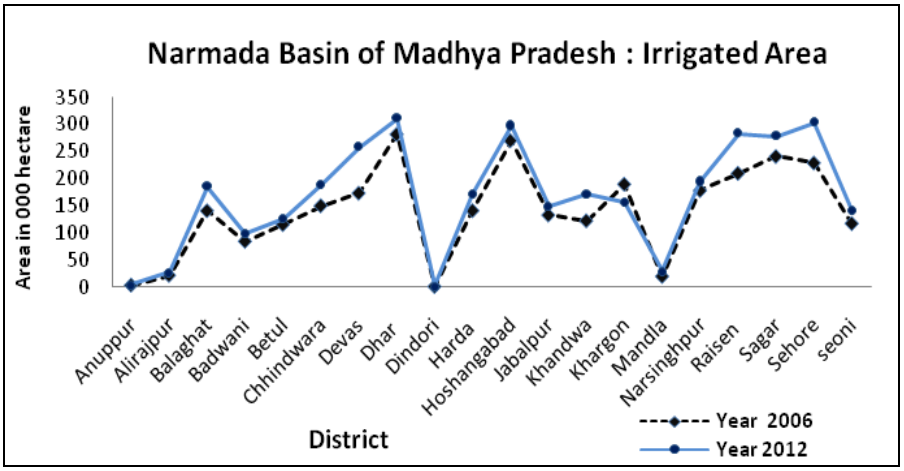
S. No.	Name of Project	Benefits (ha.)	Power (MW)	Irrigation (m^3)
Completed Projects				
1	Tawa	2.469	13.5	2386.72
2	Barna	0.548	NA	559.82
3	Kolar	0.451	NA	435.9
4	Sukta	0.166	NA	170.57
5	Matiari (Dhobatoria)	0.101	NA	88.38
6	Man Project	0.15	NA	140
7	Jobat Project	0.098	NA	112
Ongoing Projects				
8	Rani Awanti Bai Sagar	1.57	100	1008
	Bargi Diversion	2.45	NA	1853.1
9	Indirasagar Project	1.23	1000	1674
	Canal Power House of ISP	NA	15	NA
10	Omkareshwar Project	1.47	520	1300
11	Punasa lift	0.323	NA	105
12	Upper Beda	0.099	NA	90

Source: Water Resource System of India, River Projects of Narmada Basin, Web GIS.

As per available data there are 277 dams in Narmada Basin. Table no. 3 indicates Tawa, Barna, Kolar Sukta, Man and Jobat are the project, has completed. 7 projects are presently ongoing position in Narmada basin of Madhya Pradesh. The Narmada River Development Authority has planned to build of 30 big dams, 135 medium dams and 3000 small dams on the Narmada & its tributaries. The longest dam in the basin is Rani Avanti Bai Sagar dam (Bargi NVDA) in Jabalpur district with a length 5.35 km. and 3432.4 MCM live storage capacity. The Kolar is the highest barrage of the basin with length of 1.195 km. and hight 15,5 m located on Kolar river in Sehore district. The major command area is found under Indira Sagar Project. Bargi, and Bargi Diversion plan, Sardar Sarovar and Tava Project has medium command area in the basin included upper Beda Matiyari and Uri project etc. The role of river project is vary important in so far sustainability of agriculture is concern.

Impact of River Valley projects

Impact of river projects is positive about irrigation but negative about agricultural land. about the impact of river project, irrigated area is increasing. It may be negative impact on sustainability. About Sardar Sarovar Dam basin has heavy loss of land, with submerging fertile land of 193 villages by making reservoir are felling within its territory populated 45,000 people. (Nayak. 2016)

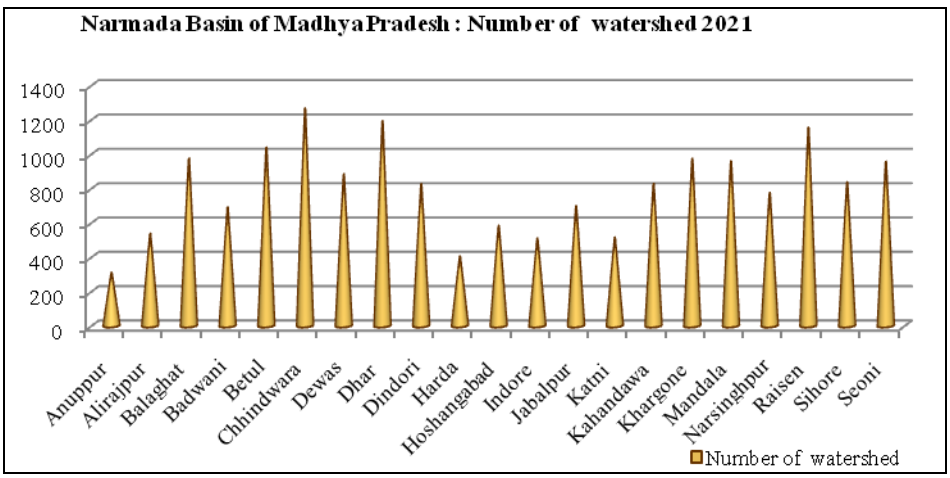


Graph 3

It is observe by the graph no. 3 that irrigated area has been increased from 2006 to 2012 The total irrigated area was 2830.6 lakh hectare in 2006 thus, it is increased of about 3383 lakh hectare could be observed during the period. It is pointed out the maximum irrigated area of Harda, Devas, Khandwa, Raisen and sehore district of middle Narmada basin has been increased during the period.

- **Watershed Management:** Basin has Study area has 408 watersheds for irrigation. Every district has even one watershed in each block. There are going on construction of 4000 irrigation tanks under Revasagar, Bhagirath Krishak Abhiyan by farmers with their own investment, their own land, for their economic development. Farmers is known as Bhagirath krishak in Dewas district.

Watershed organization trust (WOTR) Started work in Madhya Pradesh from 2006 and implemented projects related to water shade development, Climate change adaption (CCA), in Anuppur, Chhindwada, Mandala and Seoni district. Nabard water shade development projects is running in Banar, Mukarta and Kinha village under Integrated water shade management project of Mandala.

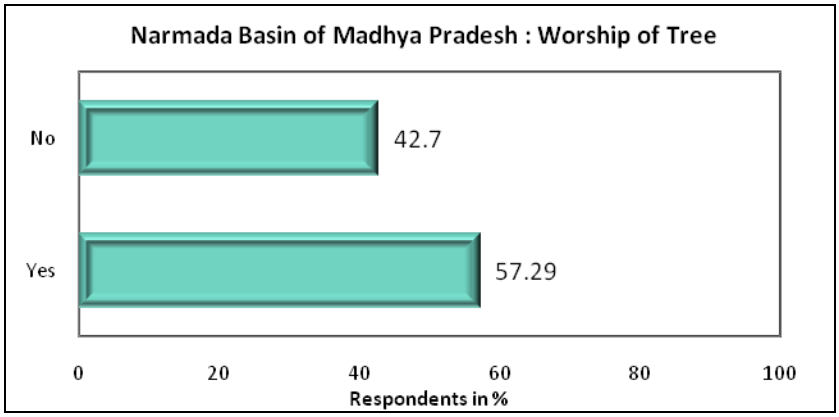


Graph 4

Through the graph no 5 information about various watersheds in the basin is given. According to current year there are 16863 micro watersheds in process. It is found that 7720 are under Upper Narmada basin, while 9143 has been considered under Middle Narmada basin Maximum 1264 watershed is recorded in Chhindwara. Most of the districts have more than 500 watersheds. Minimum quantity has been recorded in Harda district which is 10. Badwani district has high ratio between number of watershed and area. It is very important source of water in the basin and unique example of water conservation with appropriate use.

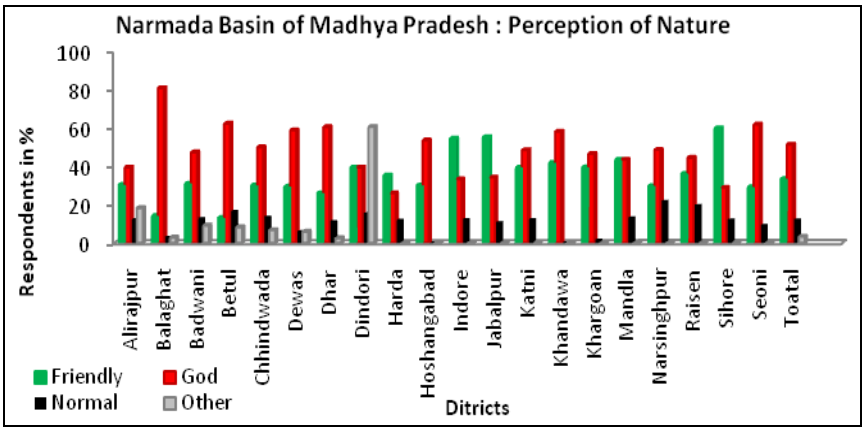
Conservation of forests and trees: The mentality of the farmers make them sincere about conservation of any resources. Farmers know that forest and trees are the source of rain and source to protect soil erosion. Agro forestry is also seen in the basin. Their mentality about forest and trees is described as under-

- **Role of Transition, Faith and Culture in Sustainability of Agriculture:** it is very important to study about the perception of farmer about nature. It may be observed that the **f**armers of study area are vary cultured and have faith on god. They think that every factors of nature like trees, land, soil, rain, sun and air are form of god. Their agricultural activities are somewhere in line with the protection of these natural factors. This may be clarify through the following interpretations.



Graph 5

It may be observed in the graph no.6 that thinking of farmers about trees as god. In each district has been found that majority of the farmers believes in worship of trees. This means they think about conservation of trees and forest. Because when a person considers something to be God, he never harm it. According to the table 5 it is clear that 57.29% of the farmers have this type of mindset related to the conservation while 42.7% of the respondents, who do not worship of tree but they also give their support in term of conservation of forest.



Graph 6

It may be occurred through the table (Appendix 6) the farmers of the basin has deferent types of opinion about the Nature. There are four type of opinion have been found which are - Friendly, God, Normal and other. According to the table it is found that highest 51.31% of the respondents think about nature as god. As well as 33.47% respondents gave their opinion about nature as friend. This is also very strong bonding with each other, while 11.89% farmers think normally to nature.

Conventional Energy Resources

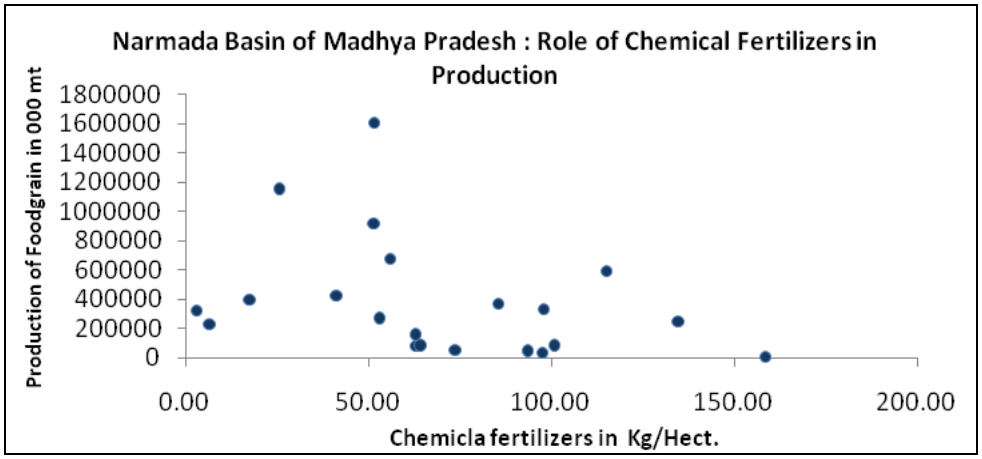
Energy resources are required in many agricultural works. The use of Biogas plants has been observed in abundance in the study area under the source of energy resource. the farmers of Jabalpur, Hoshangabad, Katni,

Bhopal, Indore, Khandwa, Khargone, Jhabua, Raisen, sihore, Alirajpur, and Mandla are using biogas as a source of energy.

Inputs of Chemical Fertilizers

In the basin cereals are main crops. Paddy, Wheat, Maize, Jowar, Kodo-Kutki, Soybean Groundnut, oilseeds, pulse and legumes are main foodgrain of the study region. Farmers use chemical fertilizers in each types of crops. N- Nitrogen P- Phosphorus and K- Potassium are main

Graph No.7



Graph 7

Study area has most of the part under deep black soil or shallow black soil which is productive soil, but according to the table those districts come under its zone they are using chemical fertilizers more than others, while production is not about the use of chemical fertilizers. Even Dindori and Anuppur are big example of district using sustainable agriculture because it has good production without using chemical or less using.

Conclusion

Conclusively the study area is advanced in context of sustainable agriculture. Paper presented an attempt of sustainability in agriculture operations. it is also analyzed the concept of sustainability in agriculture. Low input methods play an important role to gain more production with more productivity. Study area has many type of methods to prepare organic manure or compost like green manure, vermicompost, mulching etc. Some formers also recycles of organic wastes like crop residues to control of weed and and increase nutrient of soil. It is also found that for controlling soil erosion farmers make boundary frame and do plantation around the field. For paste management, some formers use bio pastiside. Here deferent types of agricultural activities play an important role in the conservation of different types of natural resources. Deferent types of measures to prevent soil erosion and use of organic manure where on one hand it increase the soil nutrient and production of crops, on other hand it protect land from other problems like chemical harms, paste harm and conserve the soil. Use of Biogas plant as a substitute of energy resource is also big example of sustainability.

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