

LAND USE CHANGE AND ITS EFFECTS ON AGRO ECOLOGY OF RICE FISH FARMING A MICRO WATERSHED BASED STUDY

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Abstract: *Wetlands are a critical part of our natural environment. In Kerala wetland ecosystem having a unique system of rice cultivation, popularly known as Pokkali and Kole in central part of Kerala and Kaipad in Northern Kerala. The unique kaipad ecosystem was most favourable for the rich diversity of fishes and its related species and it offers livelihood opportunity to the locals. A Micro watershed wise Land use study provides more detailed and scientific identification of the problems in kaipad lands and conservation of soil, water, and other natural resource of the region. Kaipad land is interconnected immersed with Watershed. Present study analyses the changing scenario of land use pattern of the study area and how the land use change affecting the agro ecology of rice- fish cultivation .The present study shows the changes in the pattern of land use and its effect on agro ecology of the area.*

Key words: Wetlands, Ecosystem, Micro Watershed, Natural Resource, Agro Ecology.

Introduction

Land is the basic resources available to human being for his survival. Land is the result of unique functions of soil, water, air, flora and fauna. Land is considered as the dynamic and limited resource, it is the complex combination of several factors like Geology, topography, hydrology, and climate. Land use means utilisation of land for several purposes, mainly based on the physical, climate, and the cultural condition. Land use information can be used to find out solution for natural resource management. The micro watershed is the logical step to plan the use and management of natural resource. Micro watershed based land use study is more specific to understand local resources and helps micro level planning strategy. In Kerala coastal belt has a unique popular system of rice cultivation in the saline wetlands like pokkali, kole and Kaipad. Kaipad is a wetland ecosystem in which salinity prone natural organic rice cultivation and aqua culture together in brackish water in the northern districts of Kerala. The area is interconnected and immersed with watershed. The tidal waves entering the field through the river keep the soil moist even during the summer months. They get rich deposits of highly fertile organic matter, therefore the paddy cultivation requires no artificial manures and fish species receive adequate food (Nair K N, Vineetha Menon, Mahesh R 2002). The complexity and high natural productivity of the environment lead us to believe that co-existence of alternative natural resource based livelihood is the key to sustainable development.

Study Area

Muttill kappu is one of the micro watersheds belong to Kaipad wetland ecosystem. The micro watershed is a part of cherukkunnu panchayath in Kannur district of Kerala. It is situated between the longitude of 75°15' 54" E to 75°17'28"E the latitudinal extension is 11° 59' 33"N to 12°01'18"N. Muttill is the place name and Kappu are the part of the river which extends towards the land area having strong effect of tidal force. Muttill kappu micro watershed belongs to the catchment area of Kuppam River. As per the watershed atlas of Kerala the code of the Micro watershed is 33K 50a. It covers an area of about 445.75 hectares of area. The ward which included in this micro watershed are 11, 12 (Muttill, Pallikkara) and part of 1, 2, and 10 (Nedumpuram, Dalil and Mundappuram). Muttill kappu micro watershed situated in the northern part of the Cherukunnu panchayath having an average height of about 10 meter. Matool River which flows in North Western boundary to easterly direction.

Objectives

The paper emphasis two objectives. They are following:

1. To analyse the changing scenario of land use pattern of the study area.
2. To study how the land use change affecting the agro ecology of rice- fish cultivation (Kaipad)

Materials and Methods

The present study is based on primary and secondary data. Both GPS survey and interview with local people used to collect information for the study. Maps like Cadastral/village, topographical sheets of 1:25000 and 1:50000 scales covering the study area form the basic information for the preparation of base maps. The boundary of the micro watershed delineated carefully from the top sheet and watershed atlas. Land use classification is done through Arc GIS 10.4 software.

Result and Discussion

Results and discussion includes the details regarding the land use change analysis and generated suitable maps, charts and figures.

Figure 01: Land use 2004

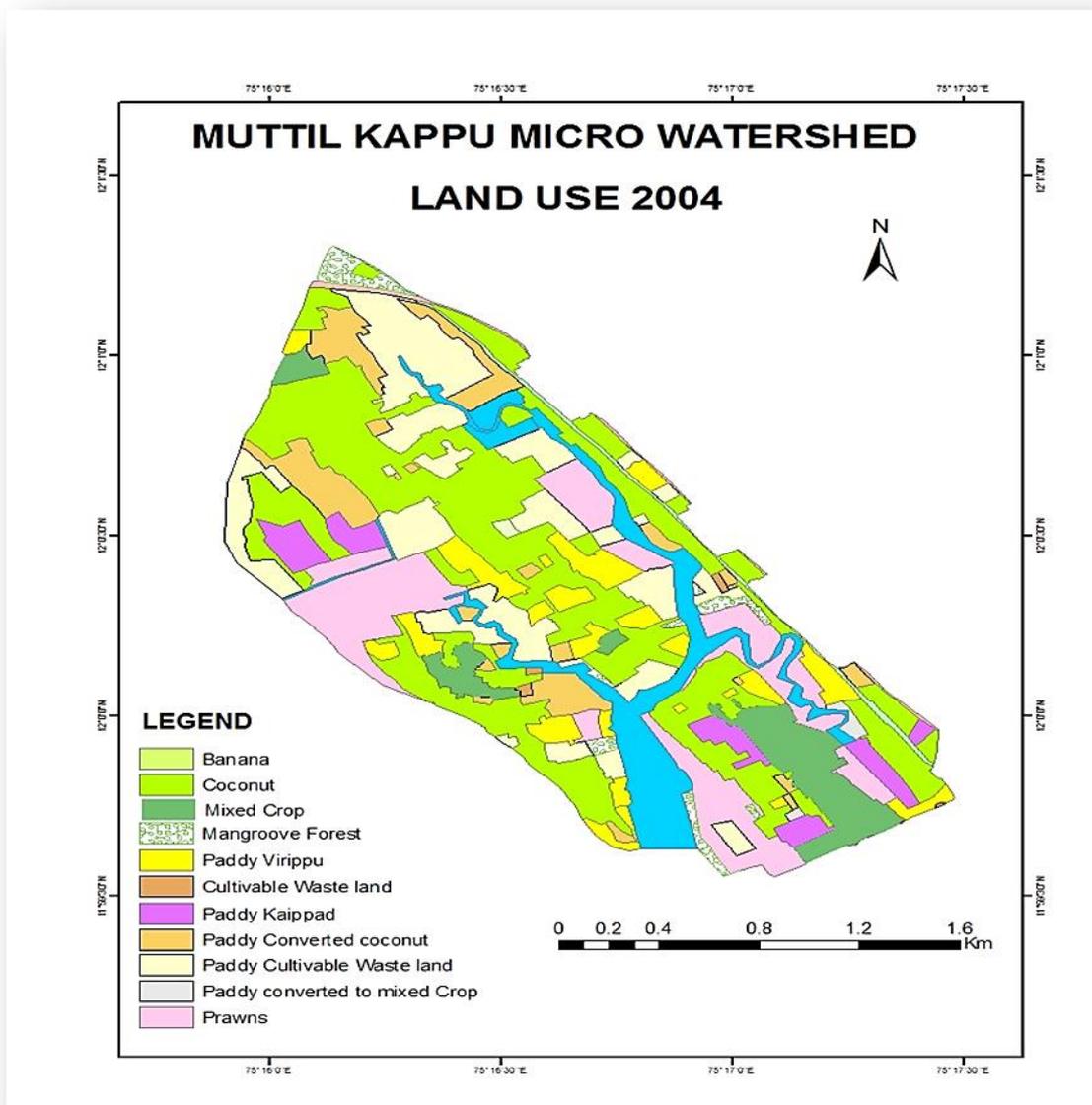


Table 01: Muttill Kappu Micro Watershed Land use, 2004

Land Use Classification	Area in Hectare	Area in Percentage
Paddy virippu	32.03	6.95
paddy kaipad	17.05	3.7
Prawns	62.67	13.59
Coconut	152.8	33.15
Paddy converted to coconut	33.46	7.26
Paddy converted mixed crops	1.42	0.31
Paddy cultivable waste land	71.54	15.52
Mangrove forest	8.35	1.81
Banana	0.41	0.41
Built up land	0.01	0
Mixed crop	29.17	6.33
Marshy land	0.97	0.21
Water bodies	42.76	9.19
Total	461	100

Source: Kerala state land use board

Muttill Kappu Micro Watershed Land Use -2004

Muttill Kappu micro watershed covers an area of about 461.05 hectares. During 2004 Paddy virippu (Paddy April, May season) covers an area of about 0.95 percent of the total area of the micro watershed. But the same time Kaipad rice cultivation was about 3.70 percent of the total area. Prawn cultivation covers an area of about 13.59 percent of the total area of the micro watershed. Coconut is the most important crop of Muttill kappu micro watershed it covers an area of about 33.15 percent of the area. Paddy cultivable waste land was 15.52 percent

Table 02: Muttill Kappu Micro watershed Land use 2016

Land Use Classification	Area in Hectare	Area in Percentage
Paddy virippu	20.62	4.47
Paddy Kaipad	4.2	0.91
Prawns	63.15	13.7
Paddy +Prawn	14.99	3.25
Kaipad Cultivable waste land	54.01	11.71
Paddy+Prawns+Fish	15.3	3.32
Paddy cultivable waste land	48.9	10.61
Coconut	124.39	26.98
Mixed Crop	37.22	8.07
Built up land	7.29	1.58
Banana	0.6	0.13
Paddy convert coconut	11.78	2.56
Cultivable waste land	0.31	0.07
Paddy convert to mixed crop	1.85	0.41
Kaippad below water	10.39	2.25
Water body	38.64	8.38
Mangrove forest	7.52	1.63
Total	461.05	100

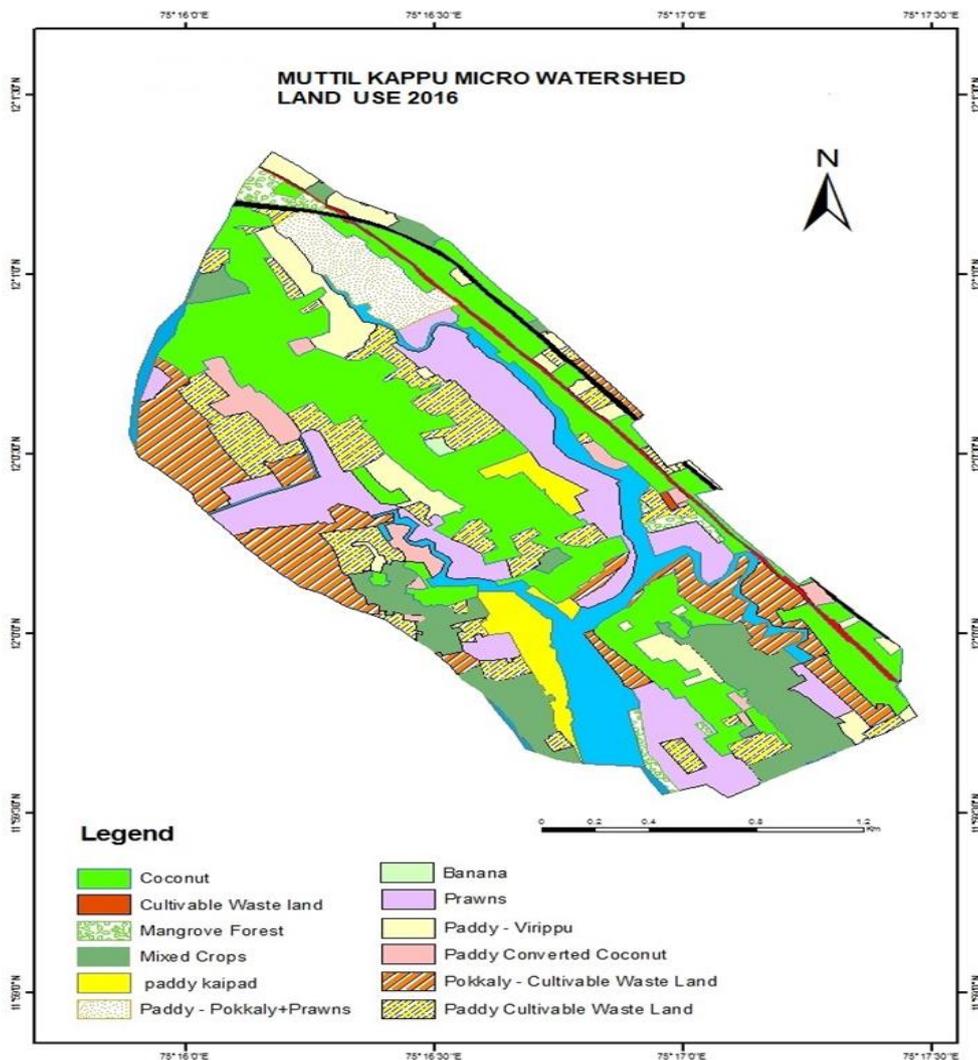
Source: Kerala state land use board

Muttill Kappu Micro Watershed Land Use 2016

During 2016 Paddy virippu cultivated at an area of 4.47 percent of the total area. Coconut is the most important crop of the Muttill kappu micro watershed it covers an area of about 26.98 percent of the area. Prawn and Paddy cultivated in the same field covers at an area of about 3.25 percent of the area in which during monsoon season paddy cultivation was done But

summer season having the cultivation of Prawn, Tidal action and Salinity is more influenced in Kaippad lands. 8.07 percent of the area utilized for the cultivation of the Mixed crop. 13.70 percent of the area was utilized for Prawn cultivation it is mainly cultivated in an unscientific manner. The evergreen Mangrove forest covers at an area of about 1.63 percent. About 11.71 percent of the area of Kaippad lands are now cultivable waste lands. Paddy lands were converted for the cultivation of other crops was more prominent in Muttill Kappu watershed about 2.56 percent.

Figure 02: Muttill Kappu Micro watershed Land use 2016

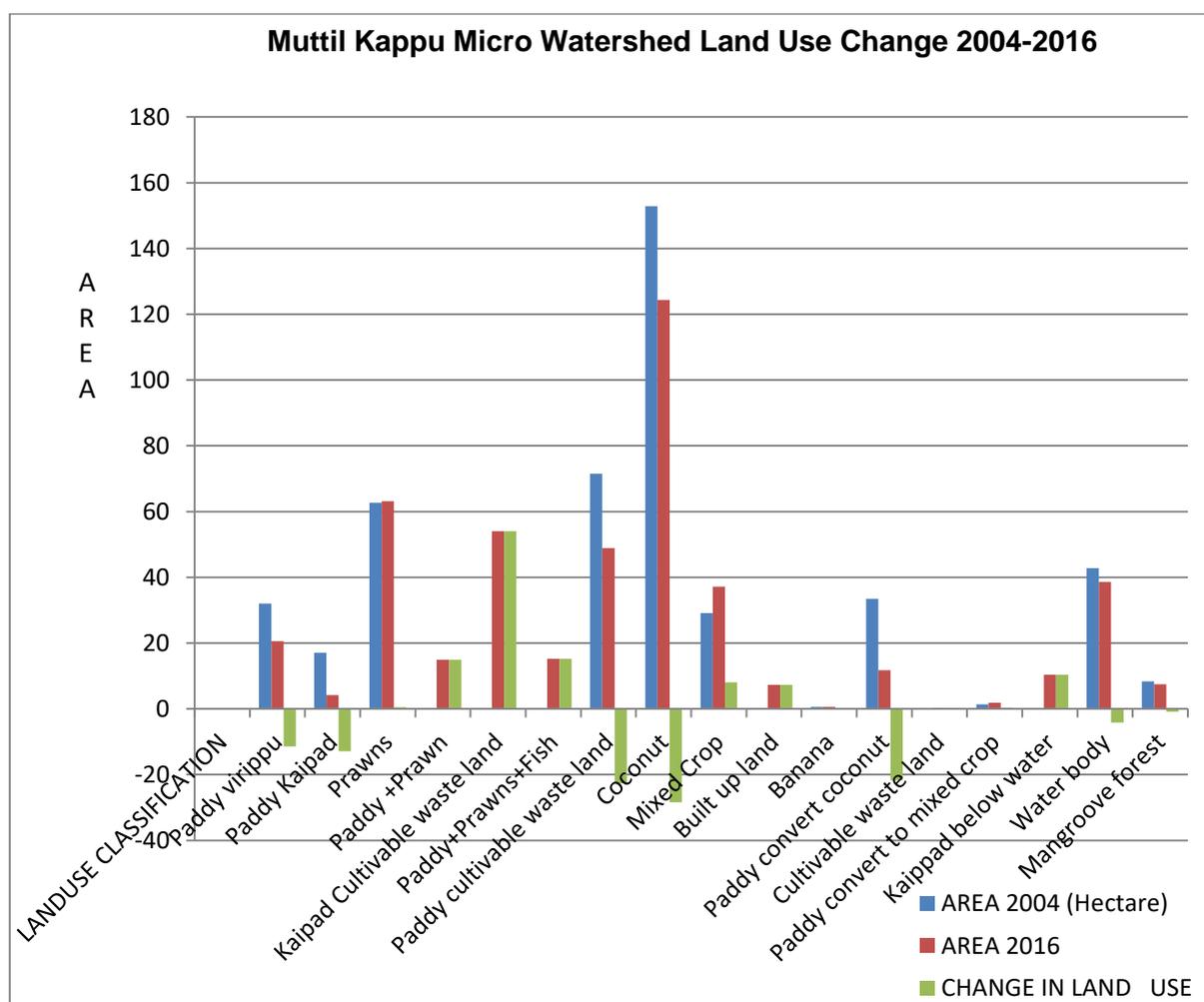


The unique kaippad ecosystem was most favourable for the rich diversity of fishes and its related species and it offers livelihood opportunity to the locals. The estuarine biodiversity contains several species of shrimps, mussels, molluscs, and several fish variety. The rich mangrove vegetation of the area also provides shelter and protection of variety of birds and aquatic ecosystem. The present study shows the changes in the pattern of land use. There was a marked change in the land uses of the kaippad lands. During 2004 Kaippad rice cultivation covers 17.5 hectares, but in 2016 it covers only 4.2 hectare area there is a tremendous change. The cultivable waste land of the paddy increased, it is mainly due to unprofitable cultivation in kaippad lands. Prawn and the paddy cultivated in the same field covers at an area of about 13.70 percent. In 2016 about 54.01 hectares area under Kaippad waste land. Kaippad lands were digging for prawn cultivation. The unscientific cultivation leads to saline water intrusion and these lands are transformed as waste land. Prawn and paddy cultivation was not prominent during 2004 but in 2016 the cultivation of prawn and paddy confined about 14.99 hectare.

Table 03: Muttill Kappu Micro Watershed Land Use Change 2004-2016

Land use Classification	Area 2004 (Hectare)	Area 2016 (Hectare)	Change in Land Use
Paddy virippu	32.03	20.62	-11.41
Paddy Kaipad	17.05	4.2	-12.85
Prawns	62.67	63.15	+0.48
Paddy +Prawn	-	14.99	+14.99
Kaipad Cultivable waste land	-	54.01	+54.01
Paddy+Prawns+Fish	-	15.3	+15.3
Paddy cultivable waste land	71.54	48.9	-22.64
Coconut	152.83	124.39	-28.44
Mixed Crop	29.17	37.22	+8.05
Built up land	0.01	7.29	+7.28
Banana	0.62	0.6	-0.02
Paddy convert coconut	33.46	11.78	-21.68
Cultivable waste land	-	0.31	+0.31
Paddy convert to mixed crop	1.42	1.85	+0.43
Kaippad below water	-	10.39	+10.39
Water body	42.76	38.64	-4.12
Mangrove forest	8.35	7.52	-0.83

Source: Kerala state land use board



Kaipad rice+Prawn+Fish farming was not done during 2004 but now 15.36 hectares were utilized .Due to the unscientific cultivation in the kaipad lands now 10.31 hectares of area is

under the water bodies.. Water bodies decreased from 42.37 Hecters to 38.64 hectare it is mainly due to the digging of kaipad lands for prawn cultivation. The evergreen mangrove vegetation was also decreased from 8.35 hectare to 7.52 hectares. Paddy cultivable waste land also reduced; there is a marked reduction in coconut cultivation about 28.44 hectare change.

Causes and Consequences

The rice culture in the kaipad lands take place either deep or floating water conditions. Even a minute change in land use effect the entire ecosystem. The reclamation of paddy lands for plantation especially for coconut cultivation is a major thread. Cultivators are interested in prawn cultivation than rice cultivation, because good international demand of prawn and also get high price in the local market. Hence prawn cultivation is increased. Kaipad cultivation abandonments have much greater implications for the livelihood of labour households who are currently involved in this activity may affect their employment and income. For prawn cultivation these wetlands were digged. It leads to the saline water intrusion towards the cultivable lands. About 11 hectors of Kaipad land are now under water due to unscientific cultivation. Population pressure is also caused such land use change. Major consequences are as follows.

Water scarcity: There is acute shortage of drinking water shortage in the micro watershed. Water scarcity mainly due to salinity condition of the area. Due to tidal forces the sea water entering into the Riverine region. The unscientific cultivation of the Prawn also leads to the water scarcity in the Watersheds. Agricultural activities are severely affected by the scarcity of water and lack of proper irrigation facilities.

Decline in agricultural productivity: Especially in Kaipad land unscientific cultivation which leads to the decline of agricultural productivity and loss of indigenous rice varieties. During 2004 Kaipad rice cultivation covers 17.5 hectares, but in 2016 it covers only 4.2 hectare area there is a tremendous change and the cultivable waste land of the paddy increase

Sliding of river banks: The banks of the streams keep sliding, due the uncontrolled flow of water during the rainy season. Deforestation of Mangrove vegetation along the banks results sliding.

Levelling of water sources: levelling of water body is more relevant especially near the Kaipad region. As the ponds and springs do not have protection, walls around it, soil get deposited in them and gradually they become levelled. In addition to this, selfish man made activities also play a major role in the levelling of water sources.

Problems related to the ecosystem Study area having rich Biodiversity both aquatic and land area. The estuarial bio diversity contains several species of shrimps, Mussels, Crab, moll uses fish verity continued. The rich mangrove vegetation also provides shelter and protection to variety of birds and aquatic ecosystem. Deforestation of mangrove vegetation leads to destruction of aquatic species. Soil nutrition reduced due to the deforestation of mangrove. Mangroves are the wet land makers, destruction leads to the continues reduction of birds and related ecosystem.

Water pollution: In Kaipad lands many pesticides were used in the Paddy field and also the feeding of prawns in kaipad lands also polluting the water. Insecticides are widely used near the streams. It spreads in water and harms the flora and fauna around it.

Water logging: It is the most important problem in kaipad lands here the water stagnant in several hours due to the tidal forces .The unscientific cultivation of the prawn in which the Kaippad fields were digging leads to large size bunds where the saline water logged for the cultivation, it leads to the drinking water shortage .

Lack of water conservation measures: Uncontrolled flow of water in streams causes massive erosion in this area. It increases the depth of streams. It also causes the sliding of

banks. There are almost similar problems in agricultural fields. Improper water conservation measures causes lots of environmental problems here.

Flood during rainy season: Being a place in the verge of crucial hot season, it also faces flood during winter. This is because of the streams are cut shortened by the people. Instead of broadening the width of the streams people are engaged in cut shortening the width of the streams.

Lack of awareness: Ground water table in this watershed area recedes considerably year after year. However, people have not started thinking of rejuvenating the water sources. It is high time to teach the importance of conserving soil, water and biomass to the people in this watershed

Suggestions

- To promote Keypad rice varieties especially GI (Geographical Indication) tag rice like Ezhome-1, Ezhome-2 etc.
- Government agencies can prepare plans to promote scientific prawn cultivation.
- Construct check dams to prevent saline water intrusion.
- Construct small scale irrigation projects within the watershed.
- Afforestation of Mangrove vegetation which is more useful to protect the bio diversity of the area especially in the case of fish farming.
- One of the major recommendations of this study is that all the existing cultivable waste land should be converted into paddy cultivation in its organic way.
- Encouragement of mangrove plantations may be helpful for reducing saltiness from the soil and it promotes rice growth.

Conclusion

Among the diverse environment near the coastal region the land use issue considered here is most pertinent to the estuarine biodiversity. The Kaipad ecosystem provide most favorable for the rich diversity of fishes and its related species and also provide high yields of paddy. Kaipad lands are the complex zones of agriculture as well as livelihood. Seepage of saline water from the prawn farms has led to acidification of soil in nearby agricultural lands. Thus there is a danger that most of the fertile lands would become barren after few years. The water bodies around the watershed provide a major role in agriculture and related activities. A minute change in land use affects the kaipad ecosystem and its sustainability.

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