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Agricultural Sector Efforts in Dealing with Climate Change in Huntu Barat Village, South Bulango District, Bone Bolango Regency

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Abstract: Global climate change, marked by rising temperatures and extreme weather phenomena, has significantly impacted Huntu Barat Village's agricultural sector, Bulango Selatan Subdistrict, Bone Bolango Regency. Most of residents of West Huntu rely on agriculture as their main source of livelihood, playing a crucial role in the local economy. Therefore, it is important to understand how farmers in this village are adapting to climate change. This study aims to (1) comprehensively identify the adaptation practices implemented by farmers in Huntu Barat Village, and (2) analyze the impacts of these practices in addressing climate change. The research employs a qualitative descriptive approach through observation and in-depth interviews with farmers, agricultural extension officers, and village officials. The study's findings indicate that the adaptation strategies applied include the selection of crop varieties that are resilient to extreme conditions, the use of organic inputs such as fermented cow urine and rice straw mulch to maintain soil fertility, and the utilization of river irrigation accompanied by simple technologies to ensure even water distribution. The integration of traditional farming techniques with local innovations not only enhances productivity and food security but also supports environmental sustainability. The synergy among these various practices demonstrates that locally implemented adaptation solutions can effectively mitigate the negative impacts of climate change and serve as a relevant model for developing agricultural strategies in other regions.

Keyword: Climate Change, Agricultural Practices, Environmental Sustainability, Huntu Barat Village

INTRODUCTION

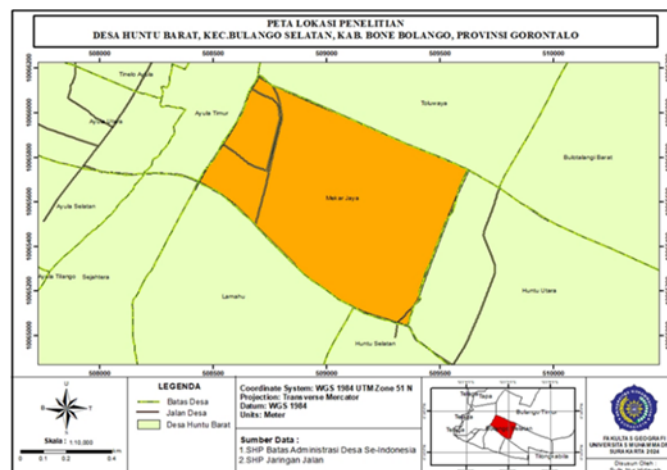
Change global climate has bring significant impact to sector agriculture in Indonesia, especially in areas that are highly dependent on agricultural activities agriculture such as West Huntu Village , District South Bulango , Bone Bolango Regency . Improvement temperature and phenomena weather extreme , which has documented in various research (IPCC, 2007; Kolopaking , 2016; Novendra et al., 2023), triggering challenge Serious for farmers , starting from drought in season drought until flood in the season rain . Condition This push farmer For adapt method more cultivation innovative use maintain productivity and resilience food . In the

context of said , farmers in West Huntu Village have develop and implement diverse practice adaptation that is innovative and based wisdom local . For example , they do election variety more plants stand to fluctuation temperature , utilizing organic inputs such as cow urine and rice waste as mulch , and optimize use river irrigation For fulfil need irrigation land (Sunardi et al., 2013; Rhofita, 2016; Salam et al., 2021). Land practices the No only functioning For guard sustainability production agriculture , but also potential reduce impact negative change climate to environment and economy local .

Study This aiming to : (1) identify in a way deep application practices adaptations that have been carried out by farmers in West Huntu Village and (2) analyzing impact from practices the in face change climate . With approach qualitative through observation and interview in-depth , research This explore how strategies like use of organic inputs and utilization source local water power can increase resilience land agriculture and reduce risk fail harvest . Findings This expected can give description comprehensive about effectiveness practices the adaptations carried out and their implications to sustainability agriculture (Aldrian et al., 2011; Speranza, 2010; Sarvina, 2019). More further , integration between practice agriculture traditional and innovation local , such as use pesticide vegetable from leaf papaya that has proven effective in control pests (Hasfita et al., 2013; Jujaningsih et al., 2021), indicating that the resulting solution nature holistic and sustainable . Utilization river irrigation as main water source , which is controlled with technology simple like pump and hose plastic , also strengthen ability adaptation farmer in manage risk drought and also flood (Ministry of Agriculture , 2010).

With identify application practice adaptations made and analyzed the impact to resilience production agriculture , research This expected can give contribution real for adaptation strategy development climate in the sector agriculture , no only in West Huntu Village , but also in other areas facing challenge similar . Approach This in line with effort government and community scientific in anticipate change climate through implementation innovation and wisdom local support sustainability environment and welfare community (BPS Bone Bolango Regency , 2019).

METHOD



Research Location Map

Study This located in Huntu Barat Village , District South Bulango , Bone Bolango Regency . West Huntu Village is located at coordinates $0^{\circ}35'53.56072''N$ $123^{\circ}4'40.06812''E$ (Figure 1). Research This use method description qualitative . Retrieval sample used in study This is purposive sampling, with involving 57 respondents from 75 farmers horticulture in West Huntu Village , which is part of in 3 groups farmers who focus on the field vegetables . Data taken originate from circles farmer horticulture in West Huntu Village and also involved 3 key persons with consider background behind work and experience they . Collected data in study

This includes primary data and secondary data . Primary data is obtained through observation , interview in-depth , study library , Data analysis methods used is approach descriptive qualitative , with to study sources literature , such as relevant books and journals , as reference.

RESULTS AND DISCUSSION

IDENTIFICATION OF APPLICATION OF ADAPTATION PRACTICES THAT HAVE BEEN CARRIED OUT BY FARMERS IN WEST HUNTU VILLAGE

Change climate characterized by with increase temperature extreme and rainfall Rain No determined has force West Huntu Village farmers for develop adaptation strategies based on local . Based on observation and interview deep with 57 farmers horticulture , three practice main identified : (1) selection variety plant stand climate , (2) use of organic inputs , and (3) utilization river irrigation . Practice This No only reflect wisdom local but also shows effort systematic in reduce vulnerability agriculture to change climate.

Election Plant Type Varieties



Images 1. Election Plant Type Varieties

Use variety adaptive plants to change climate is one of the important strategies that can applied For reduce impact negative change climate to sector agriculture . Changes climate that causes fluctuation temperature extreme , rainfall rain that doesn't fall certain , and events weather extreme others , can threaten productivity agriculture , even cause fail impactful harvest straight to the endurance food and economy society . Therefore that 's important for farmer For choose variety more kale stand to temperature extremes , drought , and potential attack a disease that often occurs triggered by change climate .

In addition to water spinach , farmers in the village this also plants a number of plant horticulture others , such as chilies , tomatoes , spinach , basil , and various type vegetables others . Plants the more Lots planted with system intercropping , which aims to For fulfil need consumption daily public local at a time increase results harvest with utilise land in a way efficient . System This intercropping is also an adaptation strategy to change climate , because with plant a number of type plant in One land , risk fail harvest can minimized if one of them type plant disturbed consequence change extreme weather . With utilization maximum land and system efficient farming , kale become commodity main supporting economy of West Huntu Village .

Utilization of organic inputs



Images 2. Organic input of cow urine (Researcher, 2024)

The more his awareness farmer will impact harm caused by use fertilizer chemistry , many from they start switch to use fertilizer organic (Figure 2) as component main in processing land . This step taken remember almost every farmer own livestock in pens or released around land agriculture they . Practice maintenance adjacent livestock with land also aims For make it easier giving sourced feed from greenery around land In addition , the processing dirt animal become fertilizer organic become more practical , so that its application on land is also more easy.

Concept This known with term integration livestock-plants (zero waste), which prioritizes principle recycle repeat source Power natural with method utilise dirt cattle as fertilizer . In Huntu Barat Village, farmers utilizing cow urine as liquid organic fertilizer , which was previously has through stage fermentation . The longer the fermentation process will more Good the result . because according to West Huntu Village Farmers Results obtained The same with use fertilizer chemistry quality more Good Because even often considered as alternative replacement fertilizer chemistry . One of them extension worker agriculture state ,

“Biasanya, kalau pupuk cair, kami mencoba mengaplikasikan dengan menggunakan urine sapi sebagai pengganti pupuk kimia. Hasilnya juga tidak kalah bagus dengan pupuk kimia. Semakin lama proses fermentasi urine sapi, semakin bagus juga hasilnya untuk tanaman,” (R.30 tahun).

Apart from utilization fertilizer organic Farmers in West Huntu Village also take advantage of rice waste as Mulch (Figure 3). Rice waste has very diverse potential . Farmers usually utilise Straw waste for needs field agriculture and animal husbandry . Field agriculture rice straw can utilized as compost , mulch , and growth media Mushroom . Field farm rice straw is utilized as feed livestock . In West Huntu Village, the utilization of straw done farmer For replacement mulch and feed livestock . Farmers in West Huntu Village usually use straw For field crops such as kale , chilies , and vegetables other For reduce direct intensity of rainwater fall to land place they plant .

“Biasanya kami memanfaatkan jerami padi untuk pengganti mulsa, ketimbang beli mulsa mahal mending pakai jerami. kami ambil dari lahan pertanian yang sudah panen dan kering memakai jerami hasil produksi tanaman kami juga bagus”(R. 65 Tahun).



Images 3. Usage straw replacement mulch For agriculture (Researcher , 2024)

Use mulch lots of rice straw used For cultivation horticulture , such as carrots , potatoes , cabbage , or broccoli . In cultivation vegetables horticulture mulch can prevent rainwater splashes that cause infection in plants . Administration mulch in season drought capable withhold hot sun on the surface on land , so that level evaporation become more low . Mulch rice straw has characteristic conductivity hot low so that the heat that arrives to surface land more A little compared to with without mulch (Rhofita, 2016) . According to Sutejo (2002) mulch organic like rice straw and rice husks can guard stability humidity in land , so that push activity microorganisms land still active indecomposition material organic For supply need nutrients needed for the growth of vegetative organs plant (Adolph, 2016) .

In addition to the use of fertilizer organic and mulch , farmers in West Huntu Village also use pesticide experience from papaya leaves , Uses pesticide organic generally impact friendly environment and not leave waste dangerous to environment , so that No impact straight to the change climate Extract Papaya leaves contain papain as protease enzyme.

Extract This can used material control in field agriculture so that reduce problem disturbance pest agriculture , accelerate production as well as reduce environmental risks (Jeana, et al, 2013) . Lots of it Papaya trees growing in West Huntu Village give rise to a sense of creativity farmer For make as pesticide natural , Use various organic inputs by farmers in West Huntu Village are intended as effort practice farmer increase contribution to agriculture in emphasize level greenhouse gas emissions glass (GHG) and capable increase Power adaptation agriculture to change climate.

Practice environmentally friendly the is form of adaptation strategy mitigation in face change climate (Ministry of Agriculture , 2010). The results of research conducted by Hasfita et al. (2013) showed that pesticide from papaya leaves are proven effective in control pest like termites , even more fast compared to with pesticide chemistry . In addition , research from Jujuaningsih et al. (2021) also strengthens benefit use pesticide experience this , especially in control pest the mover pods on plants peanut length.

This also helps reduce potential pollution environment , which becomes issue important in modern agriculture . With adopt various organic inputs , farmers in West Huntu Village play a role active in practice supportive agriculture resilience food , sustainability environment , and adaptation to change climate . This also reflects How creativity local can become solution for global problems such as change climate and pollution environment .

Utilization River Irrigation

Existence river (Figure 4) is very helpful the people of West Huntu Village in fulfil water needs for their rice fields and fields . Irrigation rivers This flow across settlement as well as various agricultural areas , both it is the rice fields and fields in West Huntu Village . In general geographical , river the is child river from the Bone River, which is one of the river main in Gorontalo Province , and flows through the sub-district area South Bulango . Existence river irrigation This own a very important role in system farming in the village said , especially For guard sustainability production agriculture throughout year . The results of research conducted by Liang Chen et al. (2017) stated impact utilization river irrigation that is not sustainable can lower temperature air average surface , as well as increase or lower flux latent heat in the irrigation area . Effects cooling This related with change evapotranspiration and flux heat generated by irrigation . In addition , irrigation also increases possibility formation clouds , which in turn influence distribution temperature air surface and rainfall rain . Utilization of river water For irrigation can to worsen change regional climate . Water diversion from river For irrigation change cycle hydrology natural and influential flow river , which has the potential reduce water availability upstream or area downstream . As a result , changes temperature and rainfall Rain can become more extreme , affecting pattern weather local and improve risk disaster natural like drought or flood . Therefore Therefore , sustainable irrigation water management is very important . For minimize impact negative to climate .



Images 4. Huntu Barat Village Irrigation River (Researcher , 2024)

flow in the river irrigation This relatively calm and not too heavy , making it a perfect fit For used as water sources that can used in a way sustainable without risk flood or high erosion . In addition to being used For irrigating fields and rice fields, river water is also used by the community local For various needs House ladder others , one of them is For wash clothes . Habits This has in progress hereditary , where society West Huntu utilizes river water as source cleanliness they everyday . For fulfil water needs for land agriculture They , the farmers in West Huntu Village rely on help technology simple , like water pump and hose plastic , which allows they For drain water from river going to land agriculture . If the river water irrigation dry they many are switching use distilled well . With use system this , the farmers can more efficient in arrange water distribution to every part land agriculture they are good That for rice fields and fields. The water pump used allow the water flow becomes more controlled , so that irrigation can done in a way evenly and optimally.

“kami biasanya langsung ambil air dari koala kalo airnya koala penuh, kalau ladang kami di belakang rumah kami pakai pompa airdan selang plastik, tapi di musim kemarau lebih sering pakai sumur suling untuk nyiram karena koala kering”(C.60)

In addition , for farmers who have garden vegetable or plant horticulture located near bank river they use a bucket to water plant They . This manual watering technique although

more simple still effective For guard humidity land around root plants . The existence of river this is very supportive success cultivation vegetables , such as chili , tomatoes and vegetables leaf others , which become commodity main for part big farmers in West Huntu Village. With existence utilization river irrigation This , farmers in West Huntu Village do not only can increase results agriculture them , but also strengthen resilience food and improve income public local . However , it is important For remember that sustainability rivers and systems irrigation This must guarded with good to stay give benefit term long for generation coming . Therefore that , it is necessary existence effort together from government , society and other parties related other For guard cleanliness and sustainability environment river , so that its utilization remain optimal and sustainable

The Impact Of Adaptive Practices In Dealing With Climate Change

In general overall , findings study show that application practices adaptive in West Huntu Village has give impact positive in face change climate . Thus , the implementation third practice the has reduce impact change climate in a way significant . Practices said , which is based on wisdom local and innovation simple , no only increase resilience food and productivity agriculture but also supports sustainability environment . Synergy interpractice create system resilient agriculture .

Election Varieties Climate-Resilient Crops : Improving Resilience Production and Economy

Election variety spinach empowered adaptive high , as planted farmers of West Huntu Village in general significant reduce risk fail harvest consequence fluctuation temperature and rainfall rain . Variety This capable withstand temperature up to 35°C (according to BMKG Gorontalo data, 2023) and has cycle harvest short (21-30 days) , so minimize exposure plant to weather prolonged extremes . Based on extension data agriculture local , productivity spinach reaching 712 kg per season plant , with income additional Rp 50,000–200,000 per plot from sales of 10–40 packages . Practice This No only stabilize supply food local but also improve income farmer by 15–20% compared to use variety conventional (Sunardi et al., 2013). In addition , the system intercropping with chili and tomatoes reduce risk loss economy up to 40%, because diversity plant ensure at least One commodity still productive although happen disturbance climate (Novendra et al., 2023). This strategy in harmony with recommendations of the Ministry of Agriculture (2010) which emphasize diversification plant as step adaptation priority.

Success cultivation spinach This No only give benefit economy for farmers , but also participate contribute to the availability supply fresh vegetables needed by the community in the local market . Considering importance role plant This in economy village , election variety resistant kale to change climate and have Power good hold to disease also becomes step strategic For increase productivity and reduce potential losses caused by factors external , such as change the weather is getting worse not unexpected , attack temperature - induced pests high , and uncertainty in pattern rainfall rain . Along with the more intensive change climate , role variety adaptive plants and techniques agriculture based on resilience climate become the more important (Anggraini et al., 2024) . Therefore that , effort For introduce and adopt more varieties stand to change climate will be very helpful for farmers in West Huntu Village to guard sustainability production agriculture they in long- term .

Use of Organic Inputs : Restoring Soil Health and Reducing GHG emissions

Use fertilizer organic liquid from fermented cow urine and rice straw as mulch has increase fertility land at a time reduce dependence on fertilizers chemistry . Cow urine fertilizer applied 2-3 times a week increase level material organic land by 1.2% in 6 months , based on analysis sample land on land respondents . This is impact on increasing production onion red

by 3.79% compared to use fertilizer chemistry (Salam et al., 2021). Rice straw as mulch proven press growth weeds up to 61% and increase groundwater retention during season drought , so that reduce frequency watering up to 30% (Rhofita, 2016). Practice this also reduces greenhouse gas emissions glass (GHG), because farmer avoid burning straw which releases 0.8–1.2 tons of CO₂ per hectare (Hasfita et al., 2013). In addition , pesticides experience from leaf pawpaw reduce groundwater pollution consequence residue chemistry , at the same time press cost production amounting to IDR 150,000–300,000 per season (Juuaningsih et al., 2021).

Utilization of Irrigation Rivers : Optimizing Water Availability and Prevention Social conflict

irrigation river become main water source for 86% of farmers in West Huntu Village , especially moment season drought . Use water pumps and distilled wells ensure water availability for 95% of land horticulture , although rainfall Rain down 30% below normal (BMKG data, 2023). Irrigation techniques This reduce risk fail harvest consequence drought from 50% to 20% in 5 years last (report group farmer , 2024). In the season rain , straw as mulch and system drainage simple on the banks river reduce sedimentation up to 25%, so that steady water flow stable (Maryati et al., 2017).

Contribution : Reducing Emissions and Supporting Sustainable Development Goals (SDGs)

Combination practice adaptation in Huntu Barat Village contributes to the achievement of the Sustainable Development Goals (SDGs), in particular **SDG 2** (Food Security) and **SDG 13** (Food Management) Climate Change). Reduction use fertilizer chemistry lower sector GHG emissions agriculture of 0.5–1 ton of CO₂ equivalent per hectare per year (Ministry of Agriculture , 2010). Meanwhile system intercropping and irrigation efficient support **SDG 12** (Consumption and Production) Responsible) with increase productivity land without area expansion (Anggraini et al., 2024). Findings This in line with studies Surmaini et al. (2017) in West Java which showed that integration wisdom local with technology simple capable reduce vulnerability climate up to 35%.

CONCLUSION

Change increasingly climate extreme , with temperature height and rainfall rain that doesn't fall determined , has give pressure big to sector agriculture in West Huntu Village. Conditions This cause challenge seriously , like risk fail harvest consequence drought in season drought and damage land agriculture consequence flood in the season rain . For anticipate impact said , the farmers has develop various innovative and resource - based adaptation strategies wisdom local.

Adaptation strategies implemented covering election variety resistant plants to condition extreme , use of organic inputs like cow urine that has been fermented and rice waste as mulch For guard fertility land , and utilization river irrigation accompanied by technology simple use ensure even distribution of water . Integration between technique agriculture traditional and innovation local This No only increase productivity and resilience food , but also supports sustainability environment . Synergy from various practice the prove that solution adaptation applied in a way local capable reduce impact negative change climate and become a relevant model for development of agricultural strategies in other areas .

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