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## Report for the Steering Committee: Evaluating TEEBAgriFood Options for India

## Executive Summary

This document provides options for the policy focus area for the TEEBAgriFood project in India, with a view to seeking a decision by the Project Steering Committee at its meeting on 9<sup>th</sup> October 2020. The project aims to contribute to conservation of biodiversity and ecosystem services through policy interventions in the agriculture and food sector. It is being implemented in India along with Brazil, China, Indonesia, Malaysia, Mexico, and Thailand, with funding from the European Union.

Over the past few years, there has been a resurgence in interest in sustainable agriculture in India. Several states, such as Andhra Pradesh, Himachal Pradesh, Gujarat, Chhattisgarh, Uttar Pradesh Haryana, Karnataka and Kerala, are promoting natural farming practices. Policies such as the Bharatiya Prakritik Krishi Paddhati Programme are supporting the scaling up of agro-ecological practices. The TEEB AgriFood project offers an opportunity to build on this momentum. With that background, the following options are presented to the steering committee for consideration:

- Option 1: Organic farming, Zero Budget Natural Farming (ZBNF) and agroforestry in Karnataka***
- Option 2: Organic farming, Zero Budget Natural Farming (ZBNF) and agroforestry in Andhra Pradesh***
- Option 3: Payment for Ecosystem services in Karnataka or Ganga basin***

This report evaluates these options with respect to their policy relevance and suitability to application of the TEEB for Agriculture and Food Evaluation Framework (hereafter “TEEBAgriFood framework”<sup>1</sup>). These options have been developed through an initial desk-based review, a virtual inception workshop for the [TEEB AgriFood project held on 13-14 July](#), and a meeting on 15 July between UNEP and Government of India representatives from Ministry of Environment, Forest and Climate Change (MoEFCC), National Biodiversity Authority (NBA) and Ministry of Agriculture and Farmers Welfare (MoAFW). A summary of this meeting is included with the background documents for the Project Steering Committee meeting.

Options one and two merge several measures discussed by stakeholders, reflecting a view that while ZBNF would be a worthy application, the scope could be broadened to a wider concept of organic farming, including elements of sustainable land management and agro-forestry. Option three was an additional suggestion of MoAFW during the 15<sup>th</sup> July meeting and as such was not discussed by stakeholders in the meetings on 13-14 July.

A desk-based review and internal discussions of the TEEB office reveal the following points for consideration by the Project Steering Committee.

### **Defining management practices**

1. The lack of definitional clarity around ZBNF, Community Managed Natural Farming, organic farming and natural farming, whether in Karnataka or Andhra Pradesh, implies that scenarios would need to be carefully defined to have policy relevance. Refinement of scenarios to reflect these definitional variations would be the first step in the TEEBAgriFood project.
2. This is not merely a question of semantics. The TEEBAgriFood analysis will be location-specific but the intention would be for the findings to influence other areas in India. As such we need to define ZBNF, Community Managed Natural Farming etc. with regards *specific management practices* so that the case for applying these same management practices can be made for

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<sup>1</sup> TEEB AgriFood- Annex 1

other areas. Continuing with loose definitions would be counter-productive, as what is meant by (say) ZBNF and how it is applied differs across regions.

**Option 1: Organic farming, Zero Budget Natural Farming (ZBNF) and agroforestry in Karnataka**

3. In Karnataka, although implementation of ZBNF remains nascent, organic farming is being proactively taken forward through implementation strategies of the recently released state Organic Farming Policy. Implementing a study in Karnataka would also provide an opportunity for synergies with watershed development plans.
4. There is an obvious commodity focus in Karnataka: coffee agroforestry, which has gained in prominence owing to both the Karnataka government's promotion of agroforestry and the ideal conditions provided by shade trees to coffee plantations resulting in richer coffee beans.
5. Notwithstanding this gain in prominence, there are real potential benefits in TEEBAgriFood focusing on coffee agroforestry, i.e. the job is not done. There is limited awareness on the range of agroforestry models and studies show there has been a tendency among farmers to rely on ill-suited models, i.e. a failure to optimize given local economic, ecological and social conditions. Further, models continue to focus solely on maximizing yield per hectare; the very rationale for TEEBAgriFood is to make the hitherto invisible contribution that ecosystems and biodiversity provide (and that farmers ultimately rely on) more visible and ultimately to value them, so that farmer choices do not deplete and degrade the very ecosystems that they depend on. A failure to account for these impacts on ecosystems will ultimately affect yield per hectare as well.
6. There are further important synergies with other UNEP projects. UNEP is already three years into the implementation of a project on natural capital accounting via the System of Environmental Economic Accounting (SEEA) Experimental Ecosystem Accounting (SEEA-EEA), with the Ministry of Statistics and Programme Implementation as the active focal point. As such, this project will produce for Karnataka (as its chosen case study area for scenario analysis and policy mainstreaming) statistics on ecosystem extent, ecosystem condition and the delivery of ecosystem services, in physical and monetary terms. These statistics would contribute to the development of a state-of-the-art analysis for the current TEEBAgriFood project in Karnataka, were the Steering Committee to select Option 1. Moreover, coffee is also the focus for a GEF 7 project commencing in 2021 and expected to run until 2026.
7. Although coffee agroforestry is a strong candidate, millets could also be considered given that stakeholders during the inception workshop emphasized reviving some traditional crops. Also, desk review shows that there is barely any scientific literature on the impact of different agroecological practises like agroforestry and organic/ZBNF for millets. Learnings from other related ongoing GEF projects, particularly those on strengthening traditional crops and biodiversity, will be useful for establishing the baseline.

**Option 2: Organic farming, Zero Budget Natural Farming (ZBNF) and agroforestry in Andhra Pradesh**

8. In Andhra Pradesh, ZBNF is relatively more established and better studied, leaving less scope for the TEEBAgriFood project to make an additional contribution to policy formation. Nevertheless, existing analysis has not covered all elements (e.g. health and social impacts) of the TEEBAgriFood framework, so there would be some scope for value addition.
9. However, World Agroforestry (ICRAF) and GIST Advisory are already working in the state with ZBNF using the TEEBAgriFood framework, so there would be the risk of some duplication in research. Finally, given that the state government appears already convinced of the ZBNF

approach as seen in its steps to proactively scale up the practice, a TEEBAgriFood study would arguably have limited policy impact.

### **Option 3: Payment for Ecosystem services in Karnataka or Ganga basin**

10. Desk review showed that an application of PES over a large area such as the Ganga basin could face implementation challenges. This is because the likelihood of PES being applied successfully depends on several factors, with higher success rates where: (i) there are a smaller number of agents, i.e. those providing the enhanced ecosystem services and the recipients; (ii) there is a measurable causal link between the actions of the providers and the recipients; and (iii) there are well-defined property rights.
11. Owing to the size of the Ganga basin, the large number of industries/communities affecting the delivery of ecosystem services, and the heterogeneity in property rights/land tenure arrangements, it would be difficult to operationalize a basin-wide PES scheme in the basin.
12. There would be more scope for a TEEBAgriFood assessment in the Ganga basin were a state or a smaller region to be selected. Himachal Pradesh, a mountain state in the basin, is proactively scaling up natural farming. Under the Bhartiya Prakritik Krishi Padhati (BPKP) scheme of central government; 12,000 hectares will be brought under natural farming in the state. However, there is less scope for applying agroforestry and/or PES in agriculture as it is in a hilly, forest-dominated state with subsistence agriculture being prevalent and with limited scope for agroforestry. A PES focused-study in Himachal Pradesh for the forestry sector including protected areas would likely be viable but the focus of TEEBAgriFood is on agricultural landscapes.
13. It may be possible to select another region/state in the Ganga basin which provides an opportunity for agroforestry, natural farming and/or PES applications. The prerequisites for the successful application of PES could be met, if an appropriate smaller region is selected within the basin or within the states, such as Uttar Pradesh , Jharkhand or Chhattisgarh. This might be explored further in the steering committee discussions.
14. In Karnataka state there are pilots on the ground on payment for watershed services in which civil society organizations have incentivized farmers for improved water quality by providing low interest rate loans or payment in kind. In addition, there are some studies that recommend a 'landscape label' to PES in Kodagu region of Karnataka, by which products delivered from this region could be differentiated to receive higher value added in markets.
15. In any case, it is worth noting that the TEEBAgriFood application in any region would be a necessary analytical stepping stone towards a PES scheme, rather than the implementation of a scheme itself. A TEEBAgriFood study could provide assessment and valuation of a full range of externalities and impacts, as a means for comparison of agricultural production systems. This could provide a basis for assessment of the feasibility and calibration of a PES scheme potentially linked together the various proposals in Option 1 or 2.

The remainder of this report considers each option in turn in more detail.

## Box 1- General Definitions and Context

Literature in this field uses several terms, sometimes interchangeably, to explain the agroecological practice of chemical-free agriculture. These include words such as Natural Farming, Organic Farming, Zero Budget Natural Farming, Community Based Natural Farming among other. The definitions of these terms often vary. This section gives a glimpse of these definitional variations.

### Organic Farming

Organic Farming, in a training document of the National Centre of Organic Farming, Department of Agriculture<sup>2</sup> and Cooperation, Ministry of Agriculture and Farmers Welfare India, is defined using two definitions, by FAO and USDA

#### FAO Definition<sup>3</sup>

“Organic agriculture is a unique production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity, and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs”.

#### USDA Definition<sup>4</sup>

“Organic agriculture is an ecological production management system that promotes and enhances biodiversity, biological cycles and soil biological activity. It is based on minimal use of off-farm inputs and on management practices that restore, maintain and enhance ecological harmony.”

### Zero Budget Natural Farming<sup>5</sup>:

“Zero Budget Natural Farming (ZBNF) is a farming practice that believes in natural growth of crops without adding any fertilizers and pesticides or any other foreign elements. There are four important non-negotiable guidelines to farmers practising ZBNF for : Bijamrita (seed Treatment using local cowdung and cow urine), Jiwamrita (applying inoculation made of local cowdung and cow urine without any fertilizers and pesticides), Mulching (activities to ensure favorable microclimate in the soil), and Waaphasa (soil aeration)”. “The word Zero Budget refers to the zero net cost of production of all crops (inter crops, border crops, multi crops). The inputs used for seed treatments and other inoculations are locally available in the form of cowdung and cow urine.”

<sup>2</sup>[https://ncof.dacnet.nic.in/Training\\_manuals/Training\\_manuals\\_in\\_English/Organic\\_Agriculture\\_in\\_India.pdf](https://ncof.dacnet.nic.in/Training_manuals/Training_manuals_in_English/Organic_Agriculture_in_India.pdf)

<sup>3</sup> FAO/WHO Codex Alimentarius Commission, 1999). <http://www.fao.org/organicag/oa-faq/oa-faq1/en/>

<sup>4</sup> USDA National Organic Standards Board (NOSB) definition, April 1995, <https://www.nal.usda.gov/afsic/organic-productionorganic-food-information-access-tools#define>

<sup>5</sup> [http://apzbnf.in/#:~:text=About%20ZBNF,border%20crops%2C%20multi%20crops\).](http://apzbnf.in/#:~:text=About%20ZBNF,border%20crops%2C%20multi%20crops).)

## OPTION I. Organic farming, Zero Budget Natural Farming (ZBNF), Agroforestry in Karnataka

### Context for Organic Farming in Karnataka

Karnataka became the first state in the country to unveil an Organic policy<sup>6</sup>, in 2004. Later, in 2017, the state released a new organic farming policy, building on the achievements of the older policy which had led to an increase in certified area under organic farming from 2,500 ha during 2004-05 to 93,963 ha in the state as on March 2016<sup>7</sup>. Karnataka at present stands 5<sup>th</sup> in the country in terms of total organic certified area and 3<sup>rd</sup> in terms of certified production<sup>8</sup>.

The Organic Farming policy of 2017 recognizes the importance of sustainable agriculture and the need to move away from the chemical-intensive farming practices adopted during the green revolution which resulted in the near stagnant levels of productivity in many crops. Annex 2 summarizes some key points of the policy relevant from the perspective of TEEBAgriFood implementation. There are some strong synergies and opportunities for convergence in the 11 implementation strategies of the Organic Farming Policy and the TEEB AgriFood project:

- Contribution to *Strategy 3.1- Enabling organic production practices for sustainability*: Within this strategy in particular, the TEEBAgriFood study has the potential to contribute to sub strategy numbers 1,2,6,7,8 on conservation and protection of agro-biodiversity, increasing crop diversity, promoting on-farm production of inputs, educating and supporting farmers to ensure soil and water conservation, and encouraging renewable energy resources in organic farms. TEEB would help to make the case for organic agriculture by measuring and valuing changes in ecosystem services, as well as providing evidence on health, livelihoods and other impacts. It makes and illustrates the case for “systems thinking” instead of “silo thinking” when evaluating eco-agri-food systems<sup>9</sup>.
- Contribution to *Strategy 3.2- Create awareness and opportunities leading to organic area expansion*: More scientific evidence is required to scale up organic farming in Karnataka. Within this strategy, the project has the potential to contribute to sub implementation strategy 3.2.5- ‘Subsidies on chemical fertilizers, pesticides and irrigation extended to conventional farmers to be treated as opportunity cost to organic farmers as price incentive’. This can be aptly incorporated in the TEEB study by modelling shadow prices for visible and invisible opportunity costs, thereby providing better understanding to the decision makers of the trade-offs involved.
- Contribution to *Strategy 3.7- Strengthening, Education, Research and Extension network*: Within this strategy, a TEEB study can directly contribute to sub strategy 3.7.4, ‘Strengthening scientific validation and documentation of ancient wisdom, knowledge and existing practises of successful organic farmers’. Moreover, a TEEB study can also assess carbon trading

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<sup>6</sup> The report was released by Department of Agriculture, Government of Karnataka. <https://organics-millets.in/assets/pdf/Organic-Policy-Book-English-Final.pdf>

<sup>7</sup> Government of Karnataka, <https://organics-millets.in/assets/pdf/Organic-Policy-Book-English-Final.pdf>

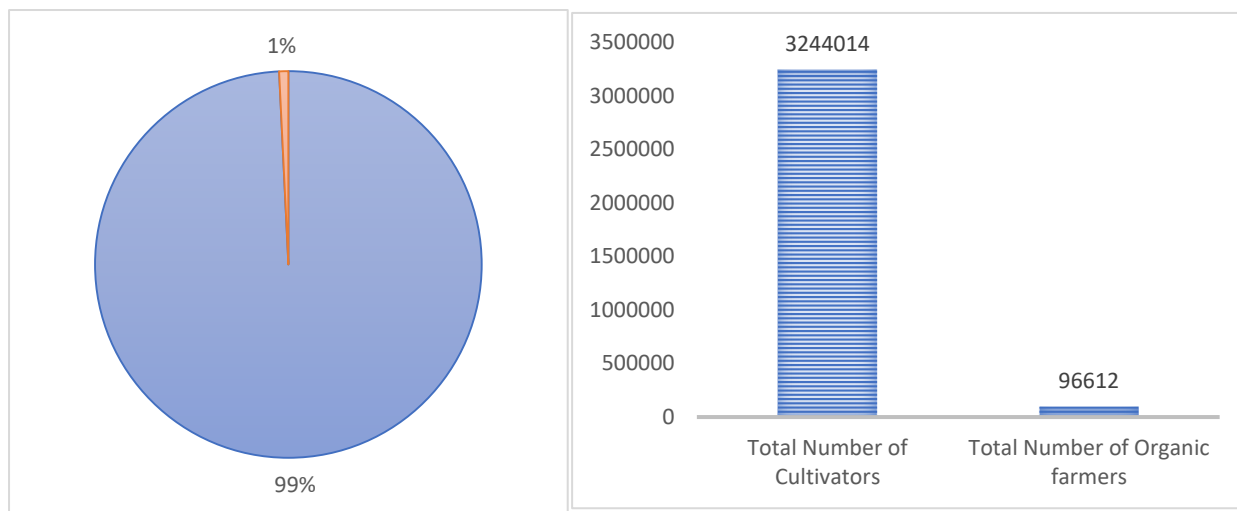
<sup>8</sup> Ibid

<sup>9</sup> <http://teebweb.org/agrifood/home/teebagrifood/>

potential thereby contributing to strategy 3.7.5, 'developing frameworks and creating opportunities for organic farmers in carbon trading'.

The Karnataka Organic policy also provides an update on the status of organic farming, Figure 1, and maps 13 crops to about 30 districts in Karnataka 'to encourage bulk and quality production through cluster approach among farmers/ farmer groups with focus on one or two predominant crops for export and domestic market'. Table 1 provides a select list of those crops and districts.

Figure 1: Status of organic farming in the Karnataka



Left panel shows the area under organic farming in the total area of the state. The net sown area in the state is 121.47 Mha, the area under organic farming is 93,963 ha. The panel on the right shows the number of farmers undertaking organic farming viz the total cultivators in the state.

Table 1 Potential region identified for Organic Farming

Crop	Potential region in Karnataka
1. Minor millets	Haveri, Chitradurga, Davanagere, Koppala
2. Paddy	Hassan (Holenarsapur Taluk for Rajmudi Rice) Davangere, Raichur, Mandya, Mysuru, Belagavi, Ballari, Uttara Kannada
3. Honey, Spices and Coffee	Chickmaglur, Shivamogga, Dakshina Kannada, Hassan, Kodagu, Uttara Kannada
4. Fruits	Dharwad, Chitradurga, Koppal, Vijayapura, Bagalkote, Belagavi
5. Cotton	Chamarajanagar

In addition, the Government of Karnataka, Department of Agriculture has a website for the promotion of organic farming and millets, [organic and millets e platform](#). The website mentions the following key activities undertaken by the Karnataka government in the area of organic farming:

- [Savayava Bhagya Yojane](#) is a project of the Karnataka government. Under the project, select NGOs are entrusted with the task of adopting 100 hectares of area in each Hobli (a cluster of adjoining villages administered together for tax and land tenure purposes). The farmers of each project area are formed into organic farmers associations and registered. Currently, this project is under implementation in 566 Hoblis of the State in an area of 63,677 hectares involving 53,829 farmers. Each project area of 100 ha is registered for group certification through Karnataka State Organic Certification Agency (KSSOCA). Assistance is extended for organic farming in the field as well as for establishing market linkages.
- An “[Organics & Millets International Trade Fair](#)”, organised annually by the Department of Agriculture, Government of Karnataka in association with ICCOA – International Competence Centre for Organic Agriculture.
- Under [Paramparagat Krishi Vikas Yojana \(PKVY\)](#), the state has initiated the implementation of this Centrally Sponsored Scheme from the year 2015-16. The programme is being implemented in all the districts & Taluks of Karnataka in project areas of 50 acres (clusters) each. A total of 545 crop-specific organic clusters have been selected throughout the state covering an area of 27,250 acres benefiting 25,968 farmers in the state<sup>10</sup>.
- The state has also put together a [directory](#) with details of all stake holders of organic farming. Separate Package of Practices for organic farming are published by the State Agriculture Universities.

<sup>10</sup> <https://organics-millets.in/assets/pdf/Schemes-of-Govt-to-promote-Organics-Millets.pdf>



As far as research on organic farming in Karnataka is concerned, [Annex 3](#) summarizes some key results of existing studies. The results indicate a positive impact of organic farming on profits of farmers and on community building, but concerns are raised with respect to inconclusive long term impact on soil in terms of nutrient balance, low yields in transition period, higher work burden on farm women, issues of farmer income stability once the support from the state sponsored programme ends.

Most literature on organic farming Karnataka is dated, from 5-10 years ago. Only a couple of studies could be found from recent years. This indicates that most studies have captured the impact of the earlier version of the organic farming policy but not the impacts of the activities spurred by the policy released in 2017. There is thus a scope to investigate the case of organic farming taking into account the recent progress, in particular after the Organic Farming Policy of 2017.

### Context for Zero Budget Natural Farming in Karnataka

Karnataka Rajya Raitha Sangha (KRRS) is an association of farmers that supports the implementation of ZBNF practices. KRRS is a farmers' movement that encourages and promotes agro-ecological methods of farming, particularly zero-budget natural farming (ZBNF), as a solution to climate change, agrarian issues, and farmer suicides<sup>11,12</sup>.

A preliminary investigation revealed only a handful of studies for ZBNF in Karnataka, details can be seen in [Annex 4](#). Most studies indicate a positive reduction in costs of cultivation but the impact on yields varies across crops. There is scope for more investigation here, as well, particularly taking into account the entire agri-food value chain and the impact on different kinds of capital.

### Context for Agroforestry in Karnataka

Karnataka Government's Forest Department is proactively taking up agroforestry through projects being implemented through forest department. One key schemes is Krishi Aranya Protsaha Yojane (KAPY). This scheme provides seedlings at subsidized rates and monetary incentive for tree planting.

In addition, the state is implementing the centrally sponsored schemes, National Bamboo Mission, National SubMission on Agroforestry. Each of the revenue districts of the state has a Social Forestry Division. These Divisions take up afforestation outside the notified forest areas and promote farm forestry and agroforestry. Under the Social Forestry Division, there are District Sector Schemes. These schemes include afforestation programs as a part of Mahatma Gandhi National Rural Employment Guarantee Scheme(MGNREGS) out of State government's Rural Development and Panchayat Raj Department funds.

In addition, 'Cauvery Calling' is a major campaign in the Cauvery watershed region. The Cauvery river originates from Kodagu hills of the Western Ghats in Karnataka state, flows east across the subcontinent, and drains into the Bay of Bengal in Tamil Nadu state. The river suffers from dry spells

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<sup>11</sup> <https://www.nonviolence.wri-irg.org/en/resources/2018/karnataka-raiya-raitha-sangha-and-amrita-bhoomi-continuing-struggle-sovereignty>

<sup>12</sup> KRRS is also a member of La Via Campesina, which is a transnational agrarian movement comprised of more than 200 organisations from over 70 countries.

during summer months. The campaign believes that increased tree cover along the river will lead to greater water transpiration and moisture cycling, and hence more rainfall, bringing an end to the seasonal drying-up of sections of the Cauvery. The campaign uses afforestation through agroforestry as a means to address this. However, scientists point out that monoculture afforestation will not be helpful; it should be adapted at the landscape level. The campaign promotes the planting of trees so as to reduce soil erosion, but some scientists highlight the real reason for erosion in the watershed could be sand mining and construction of large dams that divert water for use in irrigation and urban areas<sup>13</sup>.

An analysis on agroforestry as a component of the TEEB study for Karnataka can use information such as these as well as other relevant information in interaction with stakeholders- such as local silviculture developments in Karnataka, to further investigate the case at the landscape level, and look at various scenarios that include irrigation.

## Crops for consideration in Karnataka

While a landscape approach to crops is the basis of the systems thinking methodology of a TEEBAgriFood project study, there is the possibility of focusing on a few crops such that the results of the study also have specific and direct takeaways for policy mainstreaming. There is scope for undertaking a TEEBAgriFood study for various reasons: the national prominence of Karnataka as a coffee region; the impetus given to agroforestry and alternative agroforestry models whose externalities are not yet well-researched; and the promotion of natural farming or ZBNF for over several years. Similarly, there is opportunity for impact by undertaking an analysis on millets. The Food and Agriculture Organisation of the United Nations (FAO) has declared the year 2023 as the international year for millets<sup>14</sup>. Given this announcement, the push given to millets in the country as well as in the state of Karnataka, there is an opportunity for impact here. There is scope for research on how combining millets and different agroecological practises like agroforestry and organic/ZBNF can improve agroecological outcomes.

### a. Coffee

Karnataka is one of the top coffee producers in the India. The laterite and lateritic soils which are deeply weathered soils with a high clay content make the state suitable for the production of coffee<sup>15</sup>. Together three districts of Karnataka (Kodagu, Chikkamagaluru and Hassan) contribute to almost 69% of the total coffee production in India – see Table 2. The most commonly used coffee beans are Arabica and Robusta.

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<sup>13</sup> <https://news.mongabay.com/2020/01/mass-tree-planting-along-indias-cauvery-river-has-scientists-worried/>

<sup>14</sup> <https://poshan.outlookindia.com/story/poshan-news-the-magic-of-millets/359836>,

<https://www.thehindubusinessline.com/economy/agri-business/2023-is-international-year-of-millets-fao/article25691789.ece>

<sup>15</sup> <http://www.fao.org/3/a0257e/A0257E03.pdf>

Table 2 Production in Major States/Districts Of India (in MTs)

	Total (Arabica and Robusta)	Percentage
Chikmagalur	77,900	24%
Kodagu	1,10,730	35%
Hassan	30,920	10%
Sub total	2,19,550	69%
Grand Total (India)	3,19,500	100%

Source : [India Coffee Board](#)

However, over the past few years coffee production has been facing unstable production. Recent news reports from the state show that there have been cases where farmers have sold their coffee plantations due to erratic weather caused by cycle of droughts and heavy rainfall, exacerbated by the high cost of inputs which makes the production unviable<sup>16</sup>. As per the Status of Indian Coffee 2019 report of Karnataka Growers Federation (KGF), coffee production has fallen by 40% as input costs have increased. Input costs of fertilizers including Diammonium Phosphate (DAP), Urea, Rock Phosphate, Suphala and Potash also increased by 2.6 times in the last eight years<sup>17</sup>. Further, in 2006-07, 2007-08 and 2018-19, heavy rainfall caused severe infestation of pests and diseases like white stem borer and leaf rust, which resulted in about 30-80 per cent of plant loss.

As a result of the state government's efforts to promote agroforestry in the region and the ideal conditions provided by shade trees to coffee plantations for more aromatic and rich coffee beans, coffee agroforestry has gradually gained popularity in Karnataka. However, there is limited awareness on the correct model of agroforestry which is a win-win for both farmers in terms of more profitability and for the environment and ecosystem services. Adopting ill-suited agroforestry models can have negative externalities on ecosystem services in the region in the long run. Studies show there has been a tendency among farmers to rely on exotic tree species when scientific evidence favors the use of native species.

- Munishamapa et al (2012) carried out the study in the watershed areas of Cauvery river in the Kodagu districts of central western Ghats of India. They assessed the carbon sequestration potential of different vegetation types used for coffee based agroforestry systems. Their results showed that coffee plantations grown under the shade of native trees record the highest yields under evergreen vegetation (3.43t/ha) whilst the lowest values are for exotic plantations of moist deciduous vegetation (1.84 t/ha). Similarly, carbon content was also found to be highest in native plantations of evergreen vegetation<sup>18</sup>.
- Nath et al (2010) undertook a field-based study of diameter growth rates of four common native timber species in comparison with the fast-growing exotic species, Silver oak (*Grevillea*

<sup>16</sup><https://www.downtoearth.org.in/news/agriculture/karnataka-coffee-farmers-selling-estates-killing-themselves-report-68324>

<sup>17</sup> <https://www.financebrokerage.com/karnataka-coffee-farmers-selling-farms-killing-themselves/#:~:text=Input%20costs%20rose%20by%202.6,945%20per%20bag%20in%202019.>

<sup>18</sup> <https://www.cabi.org/isc/FullTextPDF/2012/20123322854.pdf>

robusta)<sup>19</sup>. The study conducted in three locations of Kodagu district of Karnataka explored alternative ways to improve native species conservation. It found that there is potential for native timber production to compare favourably against that of exotics, given appropriate ecological conditions<sup>20</sup>. The lack of legal rights to harvest native trees has been identified by farmers as a key problem constraining environment-friendly practices, i.e. existing laws and public policies prevent most of them from directly marketing their native timber.

- Nesper et al (2018) show that replacing native shade trees with exotic timber ones is disturbing biodiversity in ways that lower the quality of produce<sup>21</sup>. Conversion of shade cover in coffee agroforestry systems from diverse tree canopies to canopies dominated by *Grevillea robusta* (Proteaceae) reduces the inputs and cycling of several micro- and macronutrients. They list three key adverse effects. First, there is reduced soil fertility. The silver oak leaf litter takes longer to decompose and they are poorer in micronutrients, thus there is a reduced resilience to dry periods and intense monsoon rainfalls. Second, the higher the tree diversity, the lower the level of pest attacks from the berry borer beetle because more beneficial insects such as those that eat the dangerous ones are able to thrive. Third, the lower the tree diversity the higher the chance of pea-beans (single-seeded beans), possibly a result of incomplete pollination.

Thus, there is scope for value addition by investigating the case of native versus exotic species for coffee plantations taking into account the entire value chain, in the context of the natural, social, human and produced capital, and also taking into account the land tenure and livelihood implications.

There is also scope for combining both organic farming and agroforestry of coffee in the scenario building exercise for Karnataka. As we saw above, there are several studies that analyse impact of different models of agroforestry on coffee plantations. Similarly, there are studies that analyse the impact of organic farming on coffee, as can be seen in Table 3. However, there no studies to the authors' knowledge that investigate both organic farming and agroforestry together for India.

Table 3 Select Literature on Organic Farming on Coffee

	Title of Paper
Mone et al ( 2014)	<a href="#">Comparison of insect biodiversity between organic and conventional plantations in Kodagu, Karnataka, India</a>
Bai (2009)	<a href="#">Economics of organic farming vis-à-vis conventional production of robusta coffee in India.</a>
Abraham (2013)	<a href="#">Conservation and coffee production: creating synergies in Kodagu, Karnataka</a>
Garcia et al ( 2010)	<a href="#">Biodiversity Conservation in Agricultural Landscapes: Challenges and Opportunities of Coffee Agroforests in the Western Ghats, India</a>

<sup>19</sup> <http://pelissier.free.fr/pdf/2011-AgroSyst.pdf>

<sup>20</sup> <https://www.coorg.com/conserving-native-trees-coffee-agroforestry-landscape-kodagu/>

<sup>21</sup> <https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/1365-2664.13176>

There are however studies for other countries that undertake such a synergetic analysis. For instance, Hager (2012) for Costa Rica analyse the effects of management (conventional vs. organic), woody plant diversity and plant composition on aboveground and belowground C-storage in coffee agroforestry systems<sup>22</sup>. The study found that coffee agroforestry in organic farms, in particular, may contribute to GHG mitigation and biodiversity conservation more, which has implications for climate change mitigation strategies in the agricultural sector.

Thus, a TEEBAgriFood study that employs a synergetic approach to organic farming and agroforestry could have double advantages. It can also be particularly relevant for India's climate goals, given India's Nationally Determined Contribution of creating an additional carbon sink of 2.5-3 billion tonnes of carbon dioxide equivalent through additional forest and tree cover by 2030.

## b. Millets

In India, in parts of the western Ghats millets have long acted as a nutritional supplement. Although India is the largest producer of millets in the world<sup>23</sup>, between 1961 and 2012 there was drastic reduction in the area under cultivation of millets. The main reasons for decline of millets were low remuneration as compared to other competing crops, lack of input subsidies and price incentives, subsidized supply of fine cereals through Public Distribution System, and change in consumer preferences<sup>24</sup>. As a result there was a gradual shift away from millets to other crops like soybean, cotton, sugarcane and sunflower in the country.

There has been a gradual resurgence in uptake of millets in the recent decades due to a growing recognition of its health advantages<sup>25</sup> and promotional initiatives of the state government. Karnataka is proactively taking a lot of measures to promote the cultivation of millet. Consequently, there is an expectation that the millet market will grow. As per the Agricultural & Processed Food Products Export Development Authority (APEDA) of India, the market for millets stood at USD 9 billion in 2018 and is expected to be higher than USD 12 billion in 2025<sup>26</sup>. The year 2023 is also being promoted as the international year for millets by FAO.

In recent years, millet farming has been on the rise in Karnataka while there has been a drop in paddy farming due to a deficit in rainfall<sup>27</sup>. Karnataka has even declared a restriction on paddy and sugarcane cultivation in the Cauvery region due to water shortage<sup>28</sup>.

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<sup>22</sup> <https://link.springer.com/article/10.1007%2Fs10457-012-9545-1>

<sup>23</sup> [https://agriexchange.apeda.gov.in/Weekly\\_eReport/Millets\\_Report.pdf](https://agriexchange.apeda.gov.in/Weekly_eReport/Millets_Report.pdf)

<sup>24</sup> Role of Millets in Nutritional Security of India. National Academy Of Agricultural Sciences, New Delhi December 2013, <https://www.millets.res.in/books/Policy66.pdf>

<sup>25</sup> Millet have several advantages for sustainable agriculture. They can grow easily in a dry climate, have a small harvesting period and require minimal water quantity. Millet are photo-insensitive & resilient to climate change, and can withstand high temperatures, grow on poor soils with little or no external inputs. They also have health advantages. Millets contains calcium, iron and fibres which help to fortify essential nutrients for the healthy growth in children. Millets have high content of proteins and minerals such as calcium, iron etc. that can help in avoiding diseases, such as diabetes, obesity and cardiovascular.

<sup>26</sup> [https://agriexchange.min/Weekly\\_eReport/Millets\\_Report.pdf](https://agriexchange.min/Weekly_eReport/Millets_Report.pdf)

<sup>27</sup> <https://www.financialexpress.com/market/commodities/millet-farming-on-the-rise-in-karnataka/909395/>

<sup>28</sup> Kharif sowing is seen lower by 8 lakh hectares in the state due to three consecutive droughts with farming of paddy lower by 1-1.25 lakh hectares in the Cauvery region. Millets are being cultivated as they have the advantage of being short duration crop which can be harvested in 90 days. [https://economictimes.indiatimes.com/news/economy/agriculture/karnataka-spearheads-millet-cultivation-revival-in-the-country/articleshow/61276137.cms?utm\\_source=contentofinterest&utm\\_medium=text&utm\\_campaign=cppst](https://economictimes.indiatimes.com/news/economy/agriculture/karnataka-spearheads-millet-cultivation-revival-in-the-country/articleshow/61276137.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst)

Learnings from other similar projects will also be useful in the revival of millets. The revival of traditional crops has been successfully demonstrated as a part of an ongoing GEF project titled, [Mainstreaming agricultural biodiversity conservation and utilization in the agricultural sector to ensure ecosystem services and reduce vulnerability](#). The project runs from 2016 till November 2022. Under the project, to help conserve local varieties in several states of the country, 19 community seed banks have been initiated with over 2,000 traditional varieties of different crops.

A desk-based review for millets showed that there was barely any scientific evidence with respect to millets and different agroecological practises like agroforestry and organic/ZBNF. There is research by ICAR on crops for select agroclimatic zones, for instance millets in the arid region of Western Rajasthan<sup>29</sup>. However, a similar analysis for Karnataka could not be found.

## Region for consideration in Karnataka- Cauveri Watershed

Any TEEBAgriFood study must have a defined spatial scope. An investigation into the state as a whole would be a too large in terms of geographical scope. Thus there is a need to narrow down the spatial scope to a specific region. In this regard, focussing on the watershed areas of river Cauveri in Karnataka will be beneficial. Several participants during the virtual inception workshop also supported this idea stating that Karnataka has made immense progress in some watershed development programs of the government, and so it might be useful to assess the impact of these watershed services on biodiversity conservation and agriculture, in combination to natural farming and agroforestry.

Several districts of Karnataka fall under the large area of the Cauveri river's 81,000 km<sup>2</sup> watershed. Almost 36,240 sq km of the river's total drainage area lies in Karnataka<sup>30</sup>. Conservation of the watershed is of high importance for the supply of fresh water to farmers, residents of towns and cities and industry. It is a prime example of the link between maintaining a healthy forested watershed and conserving its biodiversity, including globally significant protected areas and threatened species, and meeting the needs of downstream sectors for fresh water, climate resilience and other economic benefits<sup>31</sup>.

In the Cauveri watershed region, there is also scope for synergies with ongoing watershed projects of Government of Karnataka.

The Department of Land Resources of Karnataka initiated a World Bank supported multistate project namely Rejuvenating Watershed for Agricultural Resilience through Innovative Development (REWARD), [Rejuvenating Watershed for Agriculture Resilience through Innovative Development](#), in 2011. The program is also known as the Karnataka Watershed Development Project, and known locally as Sujala. The objective is to improve land and water conservation and climate resilience in selected watersheds, and strengthen capacities of national and state institutions to deliver more effective science-based watershed development programs. It is using GIS to plan, prioritize, monitor and assess interventions in rain-fed districts in Karnataka.

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<sup>29</sup> <http://www.indiaenvironmentportal.org.in/files/file/Agroforestry%20Book.pdf>

<sup>30</sup> Cauvery Basin, Central Water Commission, Government of India, <http://cwc.gov.in/csro/about-basins>

<sup>31</sup> GEF cycle 7, PIF submitted to MoEFCC

A report by TERI presents the success of the Land Resource Inventory (LRI) developed under Sujala-3 which is being carried out in 11 districts<sup>32</sup>. Under the programme, crucial information has been collated by the National Bureau of Soil Survey and Land Use Planning (NBSSLUP) and University of Agricultural Sciences (both of which are LRI partners), who have carried out a detailed soil profile at parcel level i.e. farmer field level. After studying different soil conditions and climatic parameters, the Land Resource Inventory (LRI) atlas was developed for each micro watershed. As of now, 85 LRI atlases have been developed for 85 micro watersheds spanning an area of 46,640.8 hectares<sup>33</sup>.

Thus, there is scope for making the baseline evaluation of TEEB richer by incorporating the Cauveri watershed. It is noteworthy that there have been water disputes among neighboring states that share the water of this basin, the states of Karnataka and Tamil Nadu<sup>34</sup>.

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<sup>32</sup> TERI <https://www.teriin.org/article/karnataka-adopts-new-approach-enhance-impact-watershed-programme>

<sup>33</sup> TERI <https://www.teriin.org/article/karnataka-adopts-new-approach-enhance-impact-watershed-programme>

<sup>34</sup> <https://www.indiawaterportal.org/articles/river-fire>

## OPTION 2. Organic farming, Zero Budget Natural Farming (ZBNF), Agro-Forestry in Andhra Pradesh

Of all the states, Andhra Pradesh is expanding the scope of ZBNF most rapidly. So far in the state, the method is used by 580,000 farmers in 3011 villages covering an area of 260,000 (in ha)<sup>35</sup>. The state aims to scale it up to 6 million farmers, cultivating eight million hectares of land from conventional synthetic chemical agriculture to ZBNF by 2024<sup>36</sup>. Details of ZBNF can be seen from Box 2.

There is a growing body of documentation about the impact of ZBNF in the form of farmers' success stories, newspaper articles, as well as reports and scientific journals in Andhra Pradesh. [Annex 5](#) provides a summary of research findings of relevant research and [Annex 6](#) a synopsis of the status of research. The literature review indicates that there is a lot of research, of varying credibility. The evidence, while still inconclusive, tends to indicate a positive impact, reduction in costs of cultivation and improvement in yields for most crops. But some research also points out the need for more investigation on long term impact on health and social aspects of farmers. In that respect, there is scope for value addition through a TEEB AgriFood study. However, a GIST Advisory study that uses the TEEB AgriFood methodology is already ongoing, so there is possible duplication and less scope for TEEB to contribute. (Note that GIST Advisory is led by Pavan Sukhdev, the TEEB Study Lead.)

In general, a TEEB project is intended to consider policy options where decision makers need more information to make their choice. The Government of Andhra Pradesh, however, seems to be already convinced about the positive impact of ZBNF. This can be seen by the fact that [ZBNF success stories are embedded in the AP government website](#) in Telegu and English, this includes 16 videos of different farmers success stories. The Government of Andhra Pradesh also has a [vision 2024](#) with respect to ZBNF, 'Zero-Budget' Natural Farming Vision 2024: A Systemwide Transformation'. Azim Premji Philanthropic Initiative has also committed Rs 100 crores for 5 years. Funds have also been proposed by World Bank Rs 261 crore, IFAD Rs 104 crore and KfW 2,479 crore.

In contrast to ZBNF discussed above, as far as the broader umbrella of organic farming in Andhra Pradesh is concerned, the literature is dated, with the timing of published studies being between 2011-2015<sup>37</sup>. A reason for this could be that the government has been widely promoting ZBNF.

With regard to agroforestry, similar to Karnataka, Andhra Pradesh also has Social forestry divisions which undertake various afforestation schemes in the districts under their administrative governance, in addition to implementing centrally sponsored schemes such as Sub Mission on Agroforestry (SMAF) under the National Mission for Sustainable Agriculture. As far as research in this area is concerned, some studies examine the effect of eucalyptus agroforestry plantations on carbon sequestration in Andhra Pradesh such as Murthy et al (2013) and Sudh et al (2007)<sup>38,39</sup> while others examine changes in socio economic performance from adopting agroforestry such as Alavlapati et al (1995)<sup>40</sup>. There is

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<sup>35</sup> Government of Andhra Pradesh, (2020). Zero Budget Natural Farming. Available at: <http://apzbnf.in>

<sup>36</sup> Agarwal, M., (2018). Andhra Pradesh's push for zero budget natural farming inspires others. Available at: <https://india.mongabay.com/2018/09/andhra-pradeshs-push-for-zero-budget-natural-farming-inspires-others/>

<sup>37</sup> [https://scholar.google.com/scholar?start=0&q=andhra+pradesh+organic+farming&hl=en&as\\_sdt=0,5](https://scholar.google.com/scholar?start=0&q=andhra+pradesh+organic+farming&hl=en&as_sdt=0,5)

<sup>38</sup> <https://link.springer.com/article/10.1007/s11027-006-9067-0>

<sup>39</sup> <https://www.cabdirect.org/cabdirect/abstract/20133421867>

<sup>40</sup> <https://link.springer.com/article/10.1007%252FBF00713844>



also ongoing research by ICRAF World Agroforestry on an analysis that combines ZBNF and agroforestry, see more details in [Annex 5](#). ICRAF is also undertaking a study with GIST Advisory to look at a combination of ZBNF TEEB Evaluation framework in one of its studies.

Thus, this preliminary review shows that as far as Andhra Pradesh is concerned ZBNF is clearly a priority area for the government as compared to the wider umbrella of organic farming. As far as undertaking a TEEB study on ZBNF in Andhra Pradesh is concerned, desk review shows that it is a crowded terrain.

#### Box 2-Background of ZBNF in Andhra Pradesh

Andhra Pradesh Government is so far the most successful state in scaling up ZBNF in India<sup>41</sup>. Literature review on ZBNF reveals that it is regarded by some as a social movement or a farmers movement. Khadse et al (2017) argue that ZBNF movement has achieved massive scale not only because of effective farming practices, but because of a social movement motivating members through discourse, mobilizing resources from allies, self-organized pedagogical activities, charismatic and local leadership, and generating a spirit of volunteerism among its members<sup>42</sup>. Further, Khadse et al (2017) using Rosset 2015<sup>43</sup> and Wezel et al. 2009<sup>44</sup> emphasize that agroecology is not just a set of farming practices, or a scientific discipline based on ecological theory, but also a growing social movement. There has been a tendency to privilege investigation on the technical aspects of agroecology, while research on social aspects remains weaker<sup>45</sup>.

It is important to note that ZBNF in Andhra Pradesh is now increasingly also being referred to as Community Managed Natural Farming (CMNF). CMNF is so called because of the innovations to the four principles of ZBNF locally practised by the farmers on the ground. To what extent the definition of CMNF differs from ZBNF is not yet clear from a preliminary desk-based investigation of the literature. However, most literature published to date continues to refer to it as ZBNF for Andhra Pradesh.

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<sup>41</sup> <http://apzbnf.in/contact/>

<sup>42</sup> Wezel, A., S. Bellon, T. Doré, C. Francis, D. Vallod, and C. David. 2009. Agroecology as a science, a movement and a practice. A review. *Agronomy for Sustainable Development* 29: 503–15.

<sup>43</sup> Rosset, P. 2015. Social organization and process in bringing agroecology to scale. In *Agroecology for food security and nutrition proceedings of the FAO international symposium 18-19 september 2014, Italy. Rome.*

<sup>44</sup> Wezel, A., S. Bellon, T. Doré, C. Francis, D. Vallod, and C. David. 2009. Agroecology as a science, a movement and a practice. A review. *Agronomy for Sustainable Development* 29: 503–15.

<sup>45</sup> In Nicaragua, CaC first spread through the peasant organization Unión Nacional de Agricultores y Ganaderos de Nicaragua, while ANAP was the medium for CaC in Cuba. (Khadse et al. 2017)

## Option III. Payment for Ecosystem Services (PES) services in Karnataka or Ganga basin

It is important to note that Options 1 and 2 are broad focus areas which the project could implement the study on with scenarios and policy instruments to achieve those scenarios refined by the technical institute and TEEB office. In contrast, Option 3 is a specific policy instrument choice, viz. PES. The TEEBAgriFood study could help to evaluate trade-offs in the provision of ecosystem services under different production systems, thereby providing an assessment of the feasibility of, and assisting with calibration of, a PES scheme. For this option to be selected, the geographical context would need to be appropriate. Karnataka and the Ganga basin were suggested during the stakeholder consultation. Ganga basin area is a large area which has the potential to make the scope of the study wide and hence difficult to successfully implement, particularly owing to what the literature on PES reveals as being variables that determine the likelihood of a PES scheme being adopted and applied. Success depends on several factors, with higher success rates where: (i) there are a smaller number of agents, i.e. those providing the enhanced ecosystem services and the recipients; (ii) there is a measurable causal link between the actions of the providers and the recipients; and (iii) there are well-defined property rights. (i) to (iii) do not apply vis-à-vis a large-scale basin-wide PES. However, (i) to (iii) may apply if an appropriate smaller region is selected within the basin, such as Uttar Pradesh Himachal Pradesh, or Chhattisgarh.

As an alternative to the Ganga basin, Karnataka shows promise, given that there are already some trials in the state which could be further extended. There is also merit if PES could be incorporated as part of a suite of measures to achieve organic farming.

### General definition and context of PES

Payment of Ecosystem Services is most commonly defined, as per a definition by Wunder (2005), as a voluntary transaction whereby a well-defined ecosystem service (ES) is 'bought' by a minimum of one ES buyer from a minimum of one ES provider if and only if the ES provider continually secures the ES provision (i.e. with an element of conditionality)<sup>46</sup>.

PES schemes facilitates a more efficient and sustainable use of ecosystem services. In PES schemes unlike the polluter- pay principle, the beneficiaries pay, these beneficiaries can be governments, NGOs, private organizations or communal land holders.<sup>47</sup> PES schemes are also recognized as pro-poor as they enable low-income people to earn money by restoring and conserving ecosystems. Sometimes short-term incentives exist for unsustainable forestry and farming practices which disincentivize sustainable practises. In such circumstances, PES can present new incentives through regular payments for ecosystem services that promote short term switch as well as long-term sustainable use and even conservation<sup>48</sup>. The major types of ecosystem services that have been sold to date include

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<sup>46</sup> Wunder, S. 2005. Payment for environmental services: Some nuts and bolts. Jakarta, Centre for International Forestry Research (CIFOR).

<sup>47</sup> J. C. Ingram et al., Ecosystem Services 7, 10 (2014) from Naem et al ( 2015)

[https://www.researchgate.net/publication/273951319\\_Get\\_the\\_science\\_right\\_when\\_paying\\_for\\_nature%27s\\_services](https://www.researchgate.net/publication/273951319_Get_the_science_right_when_paying_for_nature%27s_services).

<sup>48</sup> Forest Trends et al (2008) Payments for Ecosystem Services: Getting Started. A primer produced by Forest Trends and the Katoomba Group in association with the United Nations Environment Programme, Nairobi.

carbon storage and sequestration, wetlands conservation, watershed protection (including soil protection), species, habitat, and biodiversity conservation<sup>49</sup>.

In India, at the national level, there has been some debate about the importance and the need for payment for ecosystems services in India but it has not yet been mainstreamed in a sustainable manner. Ecosystem services with respect to forests have been studied by the national government. The National Forestry Commission, appointed by the Ministry of Environment, Forest and Climate Change, submitted a report in 2006<sup>50</sup> and made recommendations for incentives that enhance the provision of ecosystem services. These include incentives for enhancing trees on lands not in the control of state forest departments. The report also made two specific recommendations of linking annual grants to states to conservation performance and not just forest area alone and enhancing the tax on water paid by industry and providing a portion to state forest departments. It is noteworthy that these are not PES schemes per se – rather alternative ways of incentivising pro-conservation behaviour through market incentives.

At the subnational level, some state governments have used the argument of PES to get a greater allocation of higher share in the central revenue. For instance, during the 12<sup>th</sup> Finance Commission, the Himachal Pradesh State Government demanded compensation from the Central Government for the opportunity costs of maintaining land under forest cover, reduced revenue from not logging, and the benefits of forest cover to the nation (supply of water for irrigation to the bread baskets of Punjab and Haryana, reduced silt loads, etc.)<sup>51</sup>. The auditor general of India also made a case for compensating states that maintain forest cover at the expense of their development<sup>52</sup>. Recently, the case for payment for Ecosystem Service was made by 10 Himalayan States in the 14<sup>th</sup> Finance Commission. There is merit in capitalizing on this interest in PES to recognize and demonstrate the benefits of such a PES approach in enhancing environmental and livelihood benefits through a TEEB study.

There are already some success cases of PES implementation on the ground already, in Madhya Pradesh and in Himachal Pradesh, as documented in reports of International Institute for Environment and Development (IIED)<sup>53</sup>. Examples exist of a switch to organic farming in Bhoj, Madhya Pradesh, and pilots for payment for watershed services in Changar region of Himachal Pradesh and the Bhodi-Suan and Oach-Kuhan catchments of Madhya Pradesh. All this literature can serve to enrich the baseline evaluation.

For selecting PES as a component of the TEEBAgriFood study, the region selection, however, requires careful consideration. Scientific literature warns that, while PES services can be very useful schemes for conservation purposes, their effectiveness and success depend on the manner in which they are implemented in a region. Some studies also list a series of principles and conditions to be met while designing an effective PES schemes for a regions, such as Forest Trends et al ( 2008) and Naem et al (2015).

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<sup>49</sup> Forest Trends et al (2008) Payments for Ecosystem Services: Getting Started. A primer produced by Forest Trends and the Katoomba Group in association with the United Nations Environment Programme, Nairobi.

<sup>50</sup>[https://books.google.co.in/books/about/Report\\_of\\_the\\_National\\_Forest\\_Commission.html?id=f4y1BNe2e\\_AC&redir\\_esc=y](https://books.google.co.in/books/about/Report_of_the_National_Forest_Commission.html?id=f4y1BNe2e_AC&redir_esc=y)  
<sup>51</sup><http://www.hpcc.gov.in/PDF/Forests/Sustainable%20Forest%20Management%20in%20Himachal%20Pradesh.pdf>

<sup>52</sup> <http://iced.cag.gov.in/wp-content/uploads/Valuation-of-forests-in-India.pdf>

<sup>53</sup> [http://www.fao.org/fileadmin/user\\_upload/kagera/resource/Watersheds\\_services\\_IIED.pdf](http://www.fao.org/fileadmin/user_upload/kagera/resource/Watersheds_services_IIED.pdf)

In the discussion during the stakeholder meeting, the idea of Payment for Ecosystem Services was discussed in the context of Karnataka and the Ganga Basin. Thus, in the next section, the case for feasibility of PES for Karnataka and Ganga basin is investigated briefly.

## 1. PES in Karnataka

Karnataka has demonstrated successful pilots of payment for watershed programs. In addition to these pilots, there are studies that advocate the method of 'geographical labelling' as a method of ecosystem services for coffee producing regions of Kodagu, Karnataka.

Payment for Watershed Services (PWS) is being piloted at various regions by civil society organizations<sup>54</sup>. As discussed in the previous section, Payment for Watershed services is a sub category of PES. Watershed services are environmental services provided by a watershed that produce benefits such as improved water quality or water quantity. These may also include regulation of water flow (increased dry season flows, reduced flooding), reduced siltation, improved water quality among others. The provisioning of these services to downstream users is directly influenced by upstream land use and practices. Hence, changes in upstream land use and practices have a direct impact on watershed services. This creates a market opportunity for PES schemes.

The literature review conducted for this report revealed that there is also potential to build on the research on Payment of Ecosystem Services in Kodagu region of Karnataka. FAO and UN (2011) undertook a case study of geographic indications and landscape labelling in Kodagu district, India<sup>55</sup>. They suggest that geographical indications and coffee certification schemes, or even a landscape labelling approach, could link sustainable management and environmental benefits of coffee agroforests with appropriate remuneration for producers through better access to markets and PES, and improve livelihoods for coffee farming communities. Naveen (2015) have also highlighted the importance of using a landscape labelling through a PES approach to address the environmental degradation for the Kodagu district of Karnataka<sup>56</sup>. A TEEB study using scientific scenario based biophysical modelling could build scenarios to assess the impact of such ecosystem schemes.

A GEF Cycle 7<sup>57</sup> project of Government of India is focussing on transforming agriculture through biodiversity conservation in Karnataka and Andhra Pradesh. In Karnataka, the scope of work involves working in coffee plantations for market certification that promotes sustainable agriculture through collaboration with Rainforest Alliance. TEEB office and UNEP GEF Task Office have discussed the advantages of synergizing the activities for realising the potential of the two projects. The work on PES through a TEEB study in Karnataka can feed into that proposed work.

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<sup>54</sup> Myrada is an NGO that works on PWS involving water quality improvement activities in the Gulbarga watershed of Karnataka. Their work involves creating "self-help affinity groups" (SAGs) composed of local community members that consult with local farmers about regenerating their land or leaving their land fallow to improve water quality. Payments for watershed protection programs are given in the form of low-interest loans through contracts for cash payments and some in-kind contributions such as labor.

[http://re.indiaenvironmentportal.org.in/files/state\\_of\\_water\\_2010.pdf](http://re.indiaenvironmentportal.org.in/files/state_of_water_2010.pdf)

<sup>55</sup> FAO and UN (2011) Payment for Ecosystem Services and Food Security

<sup>56</sup> [https://www.researchgate.net/publication/305109846\\_Investigating\\_the\\_Role\\_of\\_PES\\_in\\_Reviving\\_the\\_Social\\_and\\_Ecological\\_Fabric\\_of\\_Kodagu](https://www.researchgate.net/publication/305109846_Investigating_the_Role_of_PES_in_Reviving_the_Social_and_Ecological_Fabric_of_Kodagu)

<sup>57</sup> <https://www.thegef.org/project/transforming-agricultural-systems-and-strengthening-local-economies-high-biodiversity-areas>

UNEP is already working in Karnataka on a project of Natural Capital Accounting<sup>58</sup>. This provides scope for access to useful data and information that might be beneficial for future work. Studies have shown that in developing PES schemes, collecting scientifically meaningful, cost-effective baseline data is challenging. For instance, Naem et al (2015)<sup>59</sup> evaluated 118 projects across Asia, Africa, Europe, North America, South America, and Australia, to identify this as one of the guiding principles for successful PES implementation. Natural Capital Accounting and Valuation of Ecosystem Services (NCAVES) of UN statistical Division and UNEP TEEB office, is working to develop experimental ecosystem accounts at the national level. It was mentioned during the inception workshop that in Karnataka, efforts are underway to develop a full suite of ecosystem services for 14 provinces that will be eventually scaled up at the state level. That work will be used to develop scenario analysis for supporting land use planning decisions. The data and results generated from this ongoing work can be a useful source for defining a baseline. Further, these statistics will be available in the near future as the scenario analysis for NCAVES is expected to be completed by end of Q1 2021.

## 2. PES in Ganges Basin

The Ganga river basin is the largest river basin of India that covers a diverse landscape, reflecting cultural and geographical diversity of the India. The Indian government declared River Ganga as India's National River in the year 2008. This basin has a catchment area constituting 26% of the country's land mass (8,61,404 Sq. km) and supporting about 43% of its population (448.3 million as per 2001 census). It covers an area of 1,086,000 sq km, extending over India, Nepal and Bangladesh. About 79% area of Ganga basin is in India. At the national level, the basin covers 11 states viz., Uttarakhand, Uttar Pradesh, Madhya Pradesh, Rajasthan, Haryana, Himachal Pradesh, Chhattisgarh, Jharkhand, Bihar, West Bengal and Delhi<sup>60</sup>.

TEEB studies benefit the most from specific questions and scenario analysis and these may be difficult to uniformly apply at a large basin spanning across many states. Some potential risks with undertaking a PES study in the Ganga basin:

- Transparency in sharing information related to river basin management of Ganga is recognized as major challenge for effective implementation of ongoing projects in the region<sup>61</sup>. Studies on successful implementation of PES have identified that in areas where 'institutional capacity and transparency are lacking, or where resource access and ownership are in dispute' PES schemes can be difficult to implement. Successful implementation of PES requires buyer's confidence. With lack of adequate transparency, buyers will be wary of engaging in deals because they will have doubts that the activities paid for will be implemented over time<sup>62</sup>.
- Data mismanagement related to pollution control in river Ganga can mask the real situation. The Namami Gange Plan was launched in 2015 for the effective abatement of pollution,

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<sup>58</sup> NCAVES Project of UNEP and UNSD with MoSPI, Government of India

<sup>59</sup> <https://www.researchgate.net/publication/273951319> Get the science right when paying for nature's services

<sup>60</sup> <https://nmcg.nic.in/location.aspx>

<sup>61</sup> Srinivas et al(2020) Understanding the threats and challenges concerning Ganges River basin for effective policy recommendations towards sustainable development, *Environment, Development and Sustainability*, Springer

<sup>62</sup> [http://wedocs.unep.org/bitstream/handle/20.500.11822/9150/payment\\_ecosystem.pdf?sequence=1](http://wedocs.unep.org/bitstream/handle/20.500.11822/9150/payment_ecosystem.pdf?sequence=1)

conservation and rejuvenation of Ganga. Local authorities involved in cleaning the river have repeatedly been scrutinised for the slow pace of cleaning-related work<sup>63</sup>. Data inaccuracy by ground staff has also regularly come up in news media<sup>64</sup>, for instance, the National Green Tribunal has fined some local officials for inaccurate information on the 30 drains in the State<sup>65</sup>.

It is worthwhile to note that in terms of payment for ecosystem services in Ganga river basin, there has been discussion around dolphins<sup>66</sup>. The Prime Minister of India also announced the National Project for Dolphins in his August 14<sup>th</sup> 2020, Independence Day Speech<sup>67</sup>. Gangetic Dolphins, an endangered species, are found in the Ganga basin. Given this announcement, a significant push to work on dolphins can be expected to start in the coming year. To some extent, agricultural practices affect water quality and in turn dolphin habitat, and this could be within the board scope of TEEBAgriFood. However, as such, interventions in agri-food sector are not central to the dolphin conservation, so scenario building and policy assessment exercise may not be able to establish direct links.

Rather on focussing on the entire Ganga basin, however a smaller region/ state provides greater scope for application of the TEEB AgriFood study. This review found that Himachal Pradesh may be an option, given the positive activity in the context of natural farming and PES in the state. These points discussed below evaluate the selection of Himachal Pradesh in the context of this report:

**2a .** Himachal Pradesh State Forest Department released a State Policy on Payment for Ecosystem Services in 2013<sup>68</sup>. Further, as already mentioned, Himachal Pradesh lead a group of Himalayan states that demand a 'green bonus' from the Union government for conserving critical ecosystems. The demand was fuelled by the fact that together these states account for a significant share of forests of the country<sup>69</sup>. Agriculture, per se, was not the driver of this PES demand.

Nonetheless, there are areas in Himachal Pradesh, where payment for watershed services has been piloted, such as in Changar region of Himachal Pradesh. These schemes build on the success of the watershed programs in the region of Ministry of Agriculture and other partner organizations. Thus, there might be scope for PES in Himachal Pradesh. However, it will be best to look at it in combination with the other options, since during the inception workshop, natural farming and agroforestry clearly emerged as strong choices for implementation of a TEEB AgriFood study. Here the review found that with regard to natural farming, the state is extremely proactive, but not to the same extent vis-à-vis agroforestry.

**2b.**With regard to natural farming, the Government of Himachal Pradesh has proactively implemented ZBNF, known in the state as SPNF (Subash Palekar Method of Natural Farming)<sup>70</sup>.

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<sup>63</sup> <https://india.mongabay.com/2020/07/gangas-wait-for-a-cleaner-tomorrow-continues/>

<sup>64</sup> <https://www.dailymail.co.uk/indiahome/indianews/article-3153992/Gaps-galore-Ganga-data-Pollution-watchdog-underestimates-dirtiness-holy-river.html>

<sup>65</sup> <https://www.thehindu.com/sci-tech/energy-and-environment/river-ganga-unlikely-to-be-cleaned-up-by-2018/article17390253.ece>

<sup>66</sup> <https://www.wwfindia.org/?11621/national-workshop-to-assess-the-ecosystem-services-for-river-ganga>

<sup>67</sup> <https://www.wwfindia.org/?11621/national-workshop-to-assess-the-ecosystem-services-for-river-ganga>

<sup>68</sup> <https://hpforest.nic.in/pages/display/NjVzZDRhhXQ0ZjY1cw==policylaws>

<sup>69</sup> <https://www.downtoearth.org.in/news/environment/payment-for-ecosystem-services-himalayan-states-should-demand-more-65899#:~:text=Some%2014%20years%20ago%2C%20Kuhan,services%20rendered%20by%20an%20ecosystem.&text=The%20municipality%20of%20Palampur%20city,for%20keeping%20the%20catchment%20intact.>

<sup>70</sup> <https://www.youtube.com/watch?v=sr3oadSSzU&feature=youtu.be>

The project has been running for over 5 years and more actively since 2018. Since scientists say that it requires 5- 10 years for the effect of natural farming to show, as also discussed in the recently held national consultation of NITI Aayog, it might be the right time to use a TEEB study in the state to understand the impact of these activities.

The former Governor of Himachal Acharya Devrat<sup>71</sup> is a keen promoter of ZBNF. Under his administration in Himachal Pradesh<sup>72</sup>, a new scheme on ZBNF called Prakritik Kheti Kushal Kisan was announced. The state aims to bring 20,000 hectares under natural farming by 2020-21<sup>73</sup>. Under the Bhartiya Prakritik Krishi Padhati (BPKP) scheme of central government, 12,000 hectares will be brought under natural farming in the state.

The governance structure for implementing this scheme is clearly defined, which can be beneficial. The structure includes a state task force, project implementing unit, and ZBNF coordinating units at the block and district level. To encourage a bottom-up demand for ZBNF, the government under this new scheme is also providing assistance to farmers to establish infrastructure, designating one shop per village, for easy availability of ZBNF inputs, supporting cattle sheds, cow urine collection centers which are inputs to ZBNF, and certification program for ZBNF farmers. In addition, support for farmer motivation, capacity building of extension staff, mass awareness and literature are also provided. Even during the global pandemic, the governance structure worked effectively. As per a news report, district and state officials interacted with the farmers through video calls to resolve issues related to natural farming<sup>74</sup>.

As far as research on ZBNF and organic farming is concerned, several institutes are involved. A ZBNF Centre was established as a part of Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, also known as CSK Himachal Pradesh Agricultural University.

ICAR is active in the work being undertaken for ZBNF in the state. Led by ICAR<sup>75</sup>, a farmer scientist interaction was held in the state, to respond to farmers' queries related to organic farming. In addition, Annex 7 lists some key projects. There is growing literature but with a potential to add on the socio economic components, to understand implications on livelihoods, health among other things. The state also plans to develop a package of practises for various crops to be used by farmers and agriculture extension workers and undertake location-specific ZBNF with mixed cropping models<sup>76</sup>. Initial studies have been conducted for a variety of crops and have yielded positive impact for some crops and negative for other<sup>77</sup>.

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<sup>71</sup> He has now moved to Gujarat as the Governor of the state.

<sup>72</sup> <http://www.hillagric.ac.in/aboutus/registrar/pdf/2018/GA/30.05.2018/GA-30.05.2018-24882-98-29.05.2018.pdf>

<sup>73</sup> <http://www.cmohimachal.com/2020/06/20000-hectares-land-would-be-brought.html>

<sup>74</sup> <https://www.livemint.com/news/india/how-whatsapp-is-helping-himachal-farmers-amid-lockdown-11590473561716.html>

<sup>75</sup> ICAR-Agricultural Technology Application Research Institute, Zone-1, Ludhiana, <https://icar.org.in/node/8283>

<sup>76</sup> <http://himachalpr.gov.in/PressReleaseByYear.aspx?Language=1&ID=12202&Type=2&Date=27/05/2018>

<sup>77</sup> In case of radish, 31 per cent higher yields were obtained than under the organic system. Similarly, in cabbage, the increase was 10 per cent, whereas, in cauliflower there was no difference in yields. In some other vegetables like broccoli, kale, Chinese cabbage and pea, the yields were five to 10 per cent lower in ZBNF as compared to organic system, but the net returns were higher due to low input cost. Results were satisfactory in garlic, lentil, wheat, gram, gobhi sarson and linseed. The yields in these crops were either higher or slightly lower under ZBNF. PhD and MSc students are pursuing research on different aspects of natural farming

2c. As far as expansion of agroforestry is concerned, studies show that agriculture in the state is mainly subsistence, and hence there is not much scope of expanding agroforestry in this hilly state. They suggest to focus more on protecting the existing unspoiled forests, eco-restoration of the degraded forests<sup>78</sup>.

## Way Forward

1. This paper is for discussion at the steering committee meeting. The steering committee members will decide the focus area for the way forward.
2. Based on the suggestions received, a technical agency or consortium will refine the scope with the TEEB office, specifying scenarios, and policy interventions under consideration.
3. After the scenario refinement exercise of the technical agency, the steering committee members will convene again for comments and suggestions on the work before the analysis proceeds.

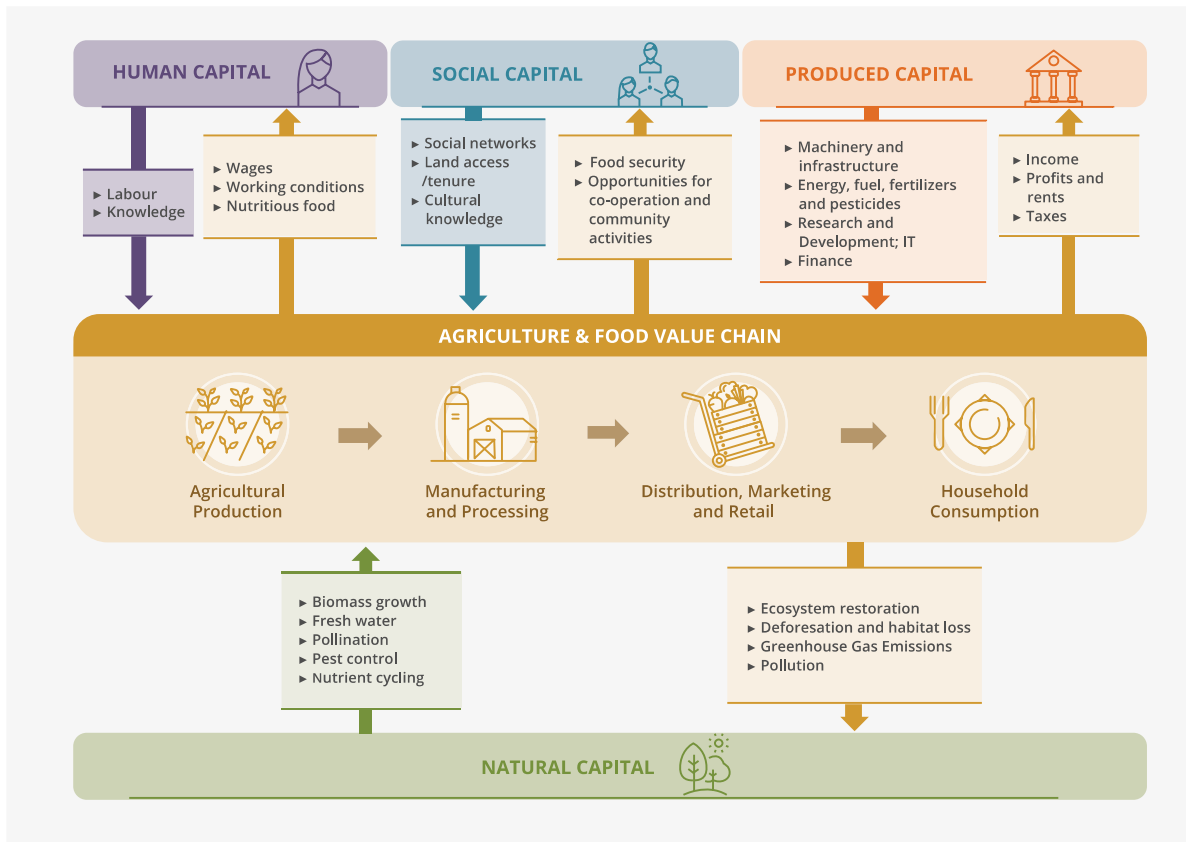
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<sup>78</sup>[https://www.researchgate.net/publication/323446116\\_Agroforestry\\_Potential\\_for\\_Increasing\\_Forest\\_and\\_Tree\\_Cover\\_in\\_Himachal\\_Pradesh-An\\_Analysis](https://www.researchgate.net/publication/323446116_Agroforestry_Potential_for_Increasing_Forest_and_Tree_Cover_in_Himachal_Pradesh-An_Analysis)



## Annex 1 Capital Stocks and value flows in eco-agri food systems



(Source: Hassain and Vause 2018)

## Annex 2 Government of Karnataka Organic Farming Policy

### **Vision**

To transform agriculture in Karnataka into a sustainable, remunerative, respectable occupation and to enable the farmers of the State to reap the benefits of dynamic market opportunities.

### **Mission**

To bring organic farming into mainstream agricultural production system which would help in transforming at least 10% of the cultivable area of the state into organic farming by 2022

To enable organics and millets farmers of the State realise 25 to 30% additional income by leverage the demands of organic market

To focus on commodity/crop specific clusters to generate bulk quantity of organic foods and

millet to meet the growing demand of domestic as well as export market

To improve the quality of organic foods and millets by extending state support to investors for the establishment of necessary supply chain and infrastructure facilities to process and market

To safeguard the interest of the consumers by putting in place suitable regulatory measures, which would facilitate in upholding the principles of traceability, accountability and transparency in production, handling and marketing of organic produce. This helps in ensuring higher level of confidence among the public about organic produce.

#### **Five Dimensions**

1. Ecologically Sound
2. Economically Viable
3. Socially Just
4. Culturally Diverse
5. Transparent
6. Accountable

#### **Objectives:**

- To maximise production and productivity of organics and millets
- To enable farmers to mitigate and adapt to the climate change and drought situations effectively
- To maximise crop and farm diversification thereby enhancing protection against crop losses due to adverse weather conditions
- To increase farmer's income by facilitating value addition to organic produce and millets thereby reducing post-harvest losses and other wastages
- To create and strengthen local institutions for effective service delivery and sharing of knowledge and skills
- To bring in more transparency in production, handling and marketing of organic produce and to safeguard the consumers interest

Source: Karnataka Organic Farming Policy 2017<sup>79</sup>

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<sup>79</sup> <https://organics-millets.in/assets/pdf/Organic-Policy-Book-English-Final.pdf>

### Annex 3: Research on Organic farming for Karnataka

Source	Scope	Key Result for Karnataka
Patil (2014) <sup>80</sup>	Comparison of two districts for 2009	Profits with organic farming are higher than in conventional farming, except for rotations that include onion. Nutrient balance was found to be negative with organic farming indicating it may not be possible to sustain current yields in the long run with current nutrient applications
Lukar (2008) <sup>81</sup>	15 famers	Positive impact in terms of reduced the reliance on credits and the risk of crop failure due to pests, diseases and droughts, thereby reducing vulnerability. However, all farmers reported that conversion period was difficult due to temporarily declining yields.
Ravishankar (2010) <sup>82</sup>	Coorg region	The study examines the effect of organic manures on growth, yield and quality of Coorg Honey Dew papaya. The results from growth and yield characters showed that organic manures were on par with the intensive farming of chemical fertilizers. However, variations were observed with the kind of organic treatment used such as with different proportions of Farm yield manure.
Naik (2012) <sup>83</sup>	38 famers- 3 districts of Bidar Distrtict	Their findings show the importance of cluster approach for organic farming of pulses production using regression analysis.
Udin (2014) <sup>84</sup>	Livelihoods marginal organic farmers in Shimoga, Karnataka state India	The study finds positive impact of organic farming on income of farmers
Gopakkali (2013) <sup>85</sup>	Zonal Agriculture Research Station, GKVK, Bengaluru	The study examined the effect of different sources of organic manures on growth, yield, quality and economics of onion, 13 types of organic treatments were compared. It was found that impact of Enriched Biodigested Liquid Manure (EBDLM) was the maximum.
Sumangala(2013) <sup>86</sup>	50 women form three villages	Findings show that shift to organic production had positive impact on the socio economic status but

<sup>80</sup> <https://www.sciencedirect.com/science/article/abs/pii/S0264837712000087>

<sup>81</sup> <https://orgprints.org/11634/>

<sup>82</sup> [https://www.actahort.org/members/showpdf?booknrarnr=851\\_39](https://www.actahort.org/members/showpdf?booknrarnr=851_39)

<sup>83</sup> [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2124370](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2124370)

<sup>84</sup> Nazeer Udin, "Organic Farming Impact on Sustainable Livelihoods of Marginal Farmers in Shimoga District of Karnataka." American Journal of Rural Development, vol. 2, no. 4 (2014): 81-88. doi: 10.12691/ajrd-2-4-4, <http://eprints-bangaloreuniversity.in/4468/1/ajrd-2-4-4.pdf>

<sup>85</sup> <http://www.indianjournals.com/ijor.aspx?target=ijor:ija&volume=59&issue=2&article=026>

<sup>86</sup> <https://krishikosh.egranth.ac.in/handle/1/69876>

		the work burden of the organic farm women in terms of man days was comparatively more and statistically significant for women in organic farming families.
Manjunatha ( 2013) <sup>87</sup>	Northern Karnataka	Results show statistically significant influence of years of practicing organic farming on various soil health indicators.
Gowdru (2019) <sup>88</sup>	200 small-scale producers	The study examines social capital formation in different networks of organic and conventional farming systems. Results show that overall, the organic farming community is at a higher level of social capital compared to the conventional farming community.
Kumar et al ( 2018) <sup>89</sup>	Karnataka	Cost of production and benefit cost ration was calculated for ragi and maize crops of both organic and conventional farming. Benefit to cost ration was far more for ragi and maize under organic farming. (1.08 and 1.37) compared to conventional farming( 0.78 and 1.12)
Shannikodi (2013) <sup>90</sup>	Thesis	There are issues of sustainability of organic farming, once the state supported programmes launched at the start for a fixed period came to an end, farmers began transitioning to old conventional farming methods. Further, farmer from higher social castes and with bigger landholdings and higher wealth were more likely to adopt this method as the have greater scope for risk diversification.

<sup>87</sup>[https://www.researchgate.net/profile/Vishwajith\\_K\\_P/publication/281491244\\_Effect\\_of\\_organic\\_farming\\_on\\_organic\\_carbon\\_and\\_NPK\\_status\\_of\\_soil\\_in\\_Northern\\_KarnatakaIndia/links/55eac6a108ae3e1218451a8c/Effect-of-organic-farming-on-organic-carbon-and-NPK-status-of-soil-in-Northern-Karnataka-India.pdf](https://www.researchgate.net/profile/Vishwajith_K_P/publication/281491244_Effect_of_organic_farming_on_organic_carbon_and_NPK_status_of_soil_in_Northern_KarnatakaIndia/links/55eac6a108ae3e1218451a8c/Effect-of-organic-farming-on-organic-carbon-and-NPK-status-of-soil-in-Northern-Karnataka-India.pdf)

<sup>88</sup> <http://www.indianjournals.com/ijor.aspx?target=ijor:aerr&volume=32&issue=1&article=007>

<sup>89</sup>[https://www.researchgate.net/profile/Shyam\\_Singh16/publication/321165143\\_Economics\\_of\\_Organic\\_Farming\\_over\\_Conventional\\_Farming\\_-\\_A\\_Case\\_Study\\_in\\_Karnataka\\_India/links/5ee20072299bf1faac4af4e0/Economics-of-Organic-Farming-over-Conventional-Farming-A-Case-Study-in-Karnataka-India.pdf](https://www.researchgate.net/profile/Shyam_Singh16/publication/321165143_Economics_of_Organic_Farming_over_Conventional_Farming_-_A_Case_Study_in_Karnataka_India/links/5ee20072299bf1faac4af4e0/Economics-of-Organic-Farming-over-Conventional-Farming-A-Case-Study-in-Karnataka-India.pdf)

<sup>90</sup> TISS Mumbai, Thesis, <http://shodhganga.inflibnet.ac.in:8080/jspui/handle/10603/18567>

#### Annex 4: Research on ZBNF for Karnataka

Source	Scope	Key Result for Karnataka
Kumar et al ( 2019) <sup>91</sup>	55 ZBNF-adopting farmers and 61 non-ZBNF farmers in Karnataka	The impact of ZBNF on cost of crop cultivation is conclusive but on the impact on crop yields it is inconclusive. Yields are better for ZBNF-farmers for finger millet, but lower yield in paddy and sugarcane.
ICAR-NAARM ( 2019) <sup>92</sup>	2-3 districts	Preliminary results indicates that there is mixed effect on crop yield, depending upon the crop, however, farmers are able to sell the produce at premium price, due to it being organic <sup>93</sup> .
Naik et al ( 2020a) <sup>94</sup>	6 taluks of Chitradurga district in Karnataka	The impact on soil health in terms of nitrogen, phosphorus, sulphur varied across the 854 surface soil samples collected from the 6 taluks. Results inconclusive.
Naik et al ( 2020b) <sup>95</sup>	ZAHRS, Babbur farm, Hiriyur (Zone-04) during Kharif 2019-20	Cost of different treatments were compared for groundnut, ZBNF which followed four principles as in Box 2, Recommended package of practises (RPP) that used chemicals, and organic farming that used Farm Yard Manure. The results show that RPP had higher yields relative to ZBNF. But if costs, are compared, ZBNF has lesser costs.

<sup>91</sup> Kumar, R., Kumar, S., Bs, Y., & Meena, P. (2019). Natural Farming Practices in India: Its Adoption and Impact on Crop Yield and Farmers' Income. Indian Journal of Agricultural Economics, 74, 420–432.

<sup>92</sup> ICAR-NAARM. (2019). Newsletter. Available at: <[https://naarm.org.in/wp-content/uploads/2019/07/Newsletter\\_April-June-2019-ICAR-NAARM.pdf](https://naarm.org.in/wp-content/uploads/2019/07/Newsletter_April-June-2019-ICAR-NAARM.pdf)>

<sup>93</sup> The final results of this paper are not yet in public domain.

<sup>94</sup>[https://www.researchgate.net/profile/Madhu\\_G/publication/342465875\\_Soil\\_fertility\\_status\\_in\\_Taluks\\_of\\_Chitradurga\\_district\\_under\\_zero\\_budget\\_natural\\_farming\\_of\\_Karnataka/links/5f15944592851c1eff21910e/Soil-fertility-status-in-Taluks-of-Chitradurga-district-under-zero-budget-natural-farming-of-Karnataka.pdf](https://www.researchgate.net/profile/Madhu_G/publication/342465875_Soil_fertility_status_in_Taluks_of_Chitradurga_district_under_zero_budget_natural_farming_of_Karnataka/links/5f15944592851c1eff21910e/Soil-fertility-status-in-Taluks-of-Chitradurga-district-under-zero-budget-natural-farming-of-Karnataka.pdf)

<sup>95</sup>[https://journaljemt.com/index.php/JEMT/article/view/30263https://www.researchgate.net/profile/Madhu\\_G/publication/342465875\\_Soil\\_fertility\\_status\\_in\\_Taluks\\_of\\_Chitradurga\\_district\\_under\\_zero\\_budget\\_natural\\_farming\\_of\\_Karnataka/links/5f15944592851c1eff21910e/Soil-fertility-status-in-Taluks-of-Chitradurga-district-under-zero-budget-natural-farming-of-Karnataka.pdf](https://journaljemt.com/index.php/JEMT/article/view/30263https://www.researchgate.net/profile/Madhu_G/publication/342465875_Soil_fertility_status_in_Taluks_of_Chitradurga_district_under_zero_budget_natural_farming_of_Karnataka/links/5f15944592851c1eff21910e/Soil-fertility-status-in-Taluks-of-Chitradurga-district-under-zero-budget-natural-farming-of-Karnataka.pdf)

## Annex 5: Literature on ZBNF in Andhra Pradesh

Group 1: **Blogs** based on farmers success stories- Between March 5 and April 19, 2018, ten blogs about the successful application of ZBNF were published on the website of AZBNF (Andhra Pradesh Zero Budget Natural Farming). Most blogs document farmer success stories pointing towards an increase in yield and increase in income due to low expenditure made on inputs specifically by the savings made from using little or no fertilizers. For instance, one blog mentions that Andhra Pradesh has some unique varieties of mango<sup>96</sup> which were facing a decrease in flowering rate (3-10%), ZBNF practises helped in increasing the flowering rate of these mango orchards. Blogs also document that the yield loss in periods of less rainfall was lower for farmers that practiced ZBNF. Another blog mentions a teacher-turned-farmer who switched to 100% ZBNF practises and later crop cutting experiments conducted on his field showed that the yield of his field was more than double the district average (160 tonnes versus 73 tonnes per hectare).

Group 2: **News articles** - Independent news reports, based on conversations with people on the field in Andhra Pradesh, have supported ZBNF method highlighting that ZBNF leads to reduction in water consumption<sup>97</sup>, better climate resilience and successful inter-cropping<sup>98,99</sup>.

**Group 3: Scientific Journals-** There is a growing mass of scientific literature that is investigating the impact of ZBNF particularly in Andhra Pradesh.

A preliminary desk investigation points towards the following literature under Group 3:

1) RySS commissioned research studies<sup>100</sup>- These are available on the official AZBNF website. Two institutions conducted these studies and their main conclusions are summarized here:

- a) CEEW (2018a, 2019b)<sup>101</sup> assessed linkages between ZBNF and Sustainable Development Goals. The study also mapped the possible social, economic and environmental impacts of ZBNF programme in Andhra Pradesh vis-à-vis specific targets under each sustainable development goal. Using data from Crop Cutting Experiments (CCEs) of both commercial and food crops conducted in all 13 districts of Andhra Pradesh, and information on programme-level policies and interventions provided by RySS, they conclude that ZBNF farmers in AP have witnessed a sharp decline in input costs and an improvement in yields. Their findings show that the ZBNF program has potential to help achieve most of the SDGs. They also conclude that Andhra Pradesh could save nearly INR 2100 crores (~USD 292 million) in fertiliser

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<sup>96</sup> Andhra Pradesh is particularly famous for 'baginapally' and 'totapari' varieties of mangoes with Krishna, Chittoor Vizianagram, West Godavari, Guntur as the major mango growing districts in the state

<sup>97</sup> Niyogi D.G. (2018). Andhra farmers taste success with Zero Budget Natural Farming. Down to Earth. Available at:

<https://www.downtoearth.org.in/news/agriculture/andhra-farmers-taste-success-with-zero-budget-natural-farming-59445>

<sup>98</sup> <https://india.mongabay.com/2018/09/andhra-pradesh-push-for-zero-budget-natural-farming-inspires-others/>

<sup>99</sup> Niyogi D.G. (2018). Andhra farmers taste success with Zero Budget Natural Farming. Down to Earth. Available at:

<https://www.downtoearth.org.in/news/agriculture/andhra-farmers-taste-success-with-zero-budget-natural-farming-59445>

<sup>100</sup>It is also conducting research in collaboration with University of Reading, UK World Agro Forestry Centre, Nairobi, FAO & resource NGOs/Civil Society Organizations like Centre for Sustainable Agriculture, Hyderabad. The results of those studies are not yet available on the public domain

<sup>101</sup> Ibid

subsidies annually if it is scaled up Zero Budget Natural Farming (ZBNF) to all six million farm families in the state by 2024.

- b) Centre for Economic and Social studies (2019)<sup>102</sup> conducted a study using crop data for Kharif 2018-19 for 130 villages using detailed household questionnaire surveys. Their findings support that there is a reduction in costs through the application of ZBNF practises. The authors present evidence from different types of crops. All crops showed a decrease in cost of inputs, however for some crops there was a regional variation to this response. For instance, the percentage of reduction in the cost of inputs for paddy ranged from 27 per cent to 90 per cent depending on the district. The extent of decline in cost of inputs is most pronounced in case of high value crop like Cotton and vegetable crop like Tomato compared to other crops like Maize, groundnut or Bengal gram. The levels of biological input use could be higher in case of Cotton and Tomato as the levels of chemical inputs is higher in them. When looking at yields per hectare, Maize is an exception, as under ZBNF, its yield is significantly higher than that under non-ZBNF. This is presented in the Tables 4 and 5 below:

Table 1 Cost of Inputs per Acre

	ZBNF inputs	Chemical Inputs
Paddy	Rs.1706	Rs.5361
Maize	Rs.1866	Rs. 2440
Groundnut	Rs.1117	Rs. 1510
Cotton	Rs.1159	Rs. 3659
Tomato	Rs.2058	Rs. 6760
Bengal gram	Rs.1835	Rs. 3315

Table 2 Yield of crops (Quintals/ acre)

Crop	ZBNF	Non ZBNF	Yield Significantly Differ between ZBNF and Non-ZBNF
Maize	20.81	15.95	*Significant
Groundnut	5.40	4.66	Not Significant
Cotton	4.53	4.27	Not Significant
Bengal gram	7.08	6.88	Not Significant
Tomato	151.85	149.15	Not Significant

2) Independent evaluation: This is independent research done by universities and research institutes, that give different positions on the impact of ZBNF.

<sup>102</sup> Galab, S. et al. (2019). Impact Assessment of Zero Budget Natural Farming in Andhra Pradesh – Kharif 2018-19 : A comprehensive approach using crop cutting experiments. CESS. Available at < <http://apzbnf.in/reports/>>

- a) Bharucha et al. (2020) use data from crop cutting experiments in Andhra Pradesh to find statistically significant differences between ZBNF and non-ZBNF yields and farmer incomes at multiple locations and with a variety of crops, as well as preliminary results on farmers' experiences with crop health and household transitions following the adoption of ZBNF<sup>103</sup>. ZBNF yields were higher than non-ZBNF yields across all districts except one (the district of West Godavari, where yields were 7% lower, likely due to anaerobic soil due to water logging, which is a normal phenomenon in the delta region). Costs of cultivation under ZBNF conditions were lower, and net incomes higher, than non-ZBNF for all crops.
  - b) Smith et al. (2020) show that a strict ZBNF system is likely to reduce soil degradation and could provide yield benefits for low-input farmers. They compared the nitrogen potentially available in a ZBNF system with the national average of fertilizer application rate in India. This includes a wide range of different systems, from high-yielding, high-input systems to low-input systems with lower yields. Their analysis found that in low-input systems, nitrogen supply is expected to increase with conversion to ZBNF, whereas in high input systems, it is more likely to decline. Yield increases associated with increased nitrogen supply may, in part, explain the observation from 88% of farmers that converting to ZBNF has achieved increased yields in the first season after conversion. Further research is needed in higher-input systems to ensure that mass conversion to ZBNF does not limit India's capacity to feed itself<sup>104</sup>.
- 3) In addition, to the studies that have already been completed, some studies are now ongoing:
- a) ICRAF is undertaking different types of studies such as soil health, greenhouse emissions, farmers welfare by examining farmers indebtedness, to assess the impact of ZBNF on social, human and natural in Andhra Pradesh. One ICRAF study spans six randomized sites across a climatic gradient and deploys a biophysical, field-survey methodology<sup>105</sup>. Its purpose is to map soil-health indicators across the entire State, track trends over time and compare ZBNF and non-ZBNF sites. A second ICRAF study, aims to develop a first, rough estimate of greenhouse-gas emissions from ZBNF fields and compare them to those from conventional, chemical-based farming practices. A third study of ICRAF is addressing impact on farmers with adoption of ZBNF in 528 village clusters across Andhra Pradesh's 13 districts. Data is being collected on farming practices, input expenditure, crop yields, food consumption, assets, savings, and levels of indebtedness.
  - b) University of Reading is undertaking research to compare the effect of Conventional, Organic and ZBNF production practices on the soil physical chemical and biological properties through 25 experiments in 5 districts of Andhra Pradesh. Another research on ZBNF by the same university, seeks to understand the contribution of various practices of ZBNF on crop growth through 5 experiments 5 districts of Andhra Pradesh

<sup>103</sup> Zareen, P.B., Sol, B.M. & Jules, P., (2020). Towards redesign at scale through zero budget natural farming in Andhra Pradesh, India, *International Journal of Agricultural Sustainability*, 18:1, 1-20, DOI: 10.1080/14735903.2019.1694465

<sup>104</sup> Smith, J., Yeluripati, J., Smith, P., & Nayak, D. R. (2020). Potential yield challenges to scale-up of zero budget natural farming. *Nature Sustainability*, 3(3), 247–252. <https://doi.org/10.1038/s41893-019-0469-x>

<sup>105</sup> <http://www.worldagroforestry.org/blog/2018/12/19/in-andhra-pradesh-icraf-starts-deep-dive-into-science-of-zero-budget-natural-farming>



- c) CIRAD, (France) FAO-UN (India) through a Foresight project are building scenarios for 2030 and 2050 with successful implementation of ZBNF, using historical data from 1970 onwards.
- d) Indian Institute of Science and Education Research (IISER) is undertaking a pollinator study , in Chittoor district of Andhra Pradesh.
- e) Council on Energy, Environment and Water (CEEW) is undertaking research on estimating the usage quantity and value of chemical fertilizer and pesticide consumption to estimate savings to Government in fertilizer subsidy as ZBNF scales up.
- f) RySS is also undertaking studies to test the potentiality of ZBNF methods for sustaining 365 Days Green cover and to strengthen district level protocols. It is also carrying out an earth worm study (all six agro-climatic zones)- Comparing earth worms population in ZBNF fields and Non-ZBNF fields - 1022 Samples exploring 1022 sq.m.

The list on literature presented here is non exhaustive and only demonstrative.

( Most part of this section is taken from the background document prepared for the virtual inception workshop held on July 13-14 2020- [add link to the document](#))

**Annex 6: Status of Research on ZBNF in Andhra Pradesh**

Scope	SDGs	Costs	Fertilizer Subsidy	Nitrogen	Yields	Soil Health	GHG Emissions	Crop Growth	2030-2050 Scenarios	Pollinators	Farmers Well-being	Logical Deduction	Empirical Analysis and Sampling	Quantitative surveys
CEEW (2019)	✓	✓	✓		✓							✓		✓
CESS (2019)		✓			✓									✓
Bharucha et al. (2020)		✓			✓								✓	
Kumar et al ( 2019)		✓			✓									✓
Smith et al (2020)				✓	✓								✓	
ICAR-CRIDA 2019					✓									✓
ICRAFa		✓			✓	✓							✓	✓
ICRAFb							✓						✓	
ICRAFc											✓			✓
University of Reading				✓		✓							✓	
University of Reading								✓					✓	
Indian Institute of Science and						✓			✓					

Education Research														
RySSa										✓				
RySSb								✓					✓	

Note: Grey shading shows studies that are in progress. White shading shows completed work.

Blue shading shows topics already studied

Yellow shading shows the research methods of used in the study

Source: Information compiled by the author based on reports with Government of Andhra Pradesh

### Annex 7: Project on Natural Farming in Himachal Pradesh

Ongoing Projects		
Funding Agency	Title of Project	Amount ( million INR)
NAHEP CAAST funded by ICAR	Protected agriculture & Natural Farming	230
State Govt. Himachal Pradesh	Evaluation, refinement & dissemination of technologies of Subhash Palekar Natural Farming (SPNF) in HP	NA
State Govt. Himachal Pradesh	Economic upliftment of tribal farmers of HP through refinement and popularization of organic farming practices	5.9
State Govt. Himachal Pradesh	A project on Zero Budget Natural Farming (ZBNF) to CSK HPKV, Palampur	30
Completed Projects		
ICAR	Organic Farming in Hill Agriculture <i>w.e.f.</i> April 2006 to March 2011	36
ICAR	Production and protection technologies for potential vegetables and pulses under organic farming system	55.3
RKVY	Development of liquid biofertilizer based integrated management <i>w.e.f.</i> April 2011 to Sept. 2013	35
RKVY	A Turn Key Organic Cluster project in 1200 ha in Himachal Pradesh <i>w.e.f.</i> October 2010 to March 2013	28
RKVY	Standardization of Processes and use of Organic Inputs in Organic Agriculture	23